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Power Generation

June 1949

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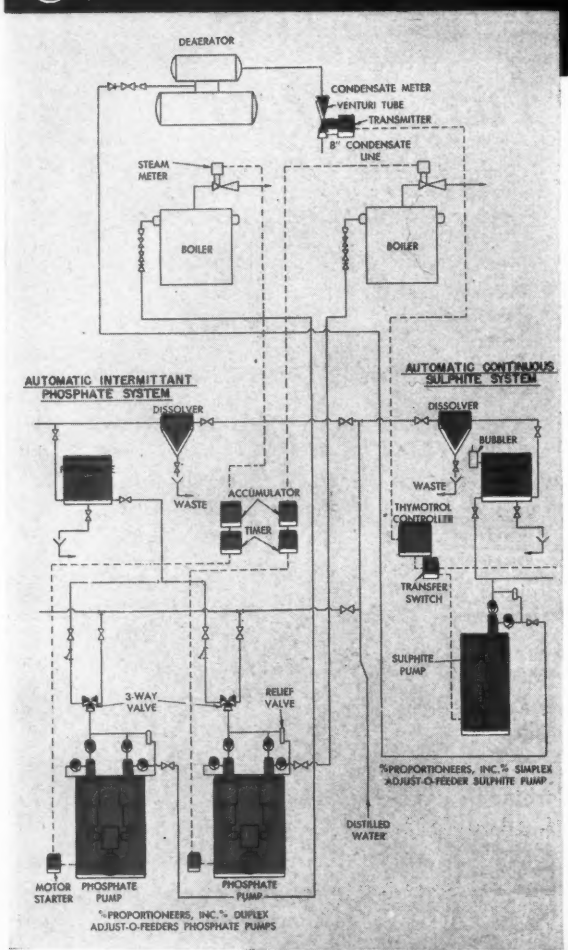
Continuous—Automatic



BOILER WATER CONDITIONING

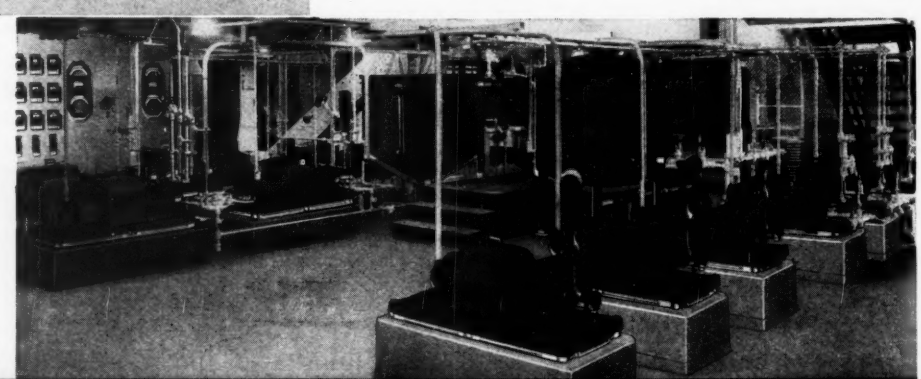
%Proportioneers% boiler water treating equipment was selected for the new Redondo Steam Station of Southern California Edison Co. built by Stone & Webster Engineering Corporation in collaboration with Edison engineers. In this, one of the most modern plants in the world, the boilers are treated automatically and in proportion to their service load. The complete %Proportioneers% system makes chemical treatment a routine procedure, reducing operator responsibility. A necessity in large plants, the %Proportioneers% system is also highly desirable in small plants to reduce manpower and give adequate protection.

We furnish complete feeding systems to engineers' specifications or, where required, can adapt our controls to existing equipment. Ask for Brochure SM 122 "Treatment of Water for Boilers".

All equipment shown red in photo and flowgram furnished by %Proportioneers, Inc.%

%Proportioneers% sulphite feed pumps in the Redondo Steam Station, in foreground; high pressure duplex phosphate pumps and control panel, in the background.

No. 3 in a series on boiler water conditioning.



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Technical service representatives in principal cities of the United States, Canada, Mexico and other foreign countries.

ENGINEERS' PREVIEW

NEED TO MAKE a usable product out of low-grade iron ores is creating a new ore processing industry which will require handling and processing equipment of new design and startling potentialities. This was explained by Harold Von Thaden, of Robins Engineers Div. of Hewitt-Robins, Inc., before the Society for Advancement of Management recently. He reviewed the development of belt conveyors and related heavy conveying techniques in the mining field in the mechanization of coal mines and in strip mining. He concluded that belt conveyors in the common carrier field are "definitely in the cards" and declared that, despite opposition, the recently-proposed 130-mile belt conveyor to carry ore and coal in Ohio was "as practical as it is daring," and would eventually be adopted.

★ ★ ★

NEEDLESS DIGITS:—Fun is fun, we always say, but the minute we try some here in the *Engineers' Preview*, it snowballs on us, just as the Inverted Check problem did, and we can't handle it mechanically. Of course, the snowballing proves that a great many engineers read the *Engineer's Preview*, a fact we sometimes doubt until we try something like the inverted check or the value of pi. But, apparently, power engineers read the *Engineers' Preview*, a fact we somethe little, hard, round facts of their profession.

Among these is the famous C. Harold Berry, Gordon McKay Professor of Engineering Science at Harvard University who read the little jingle in the February *Engineers' Preview* "alleged to facilitate remembering the constant pi to needless digits." Well, says Professor Berry, might as well have some more like this:

Que J'aime à faire apprendre un nombre utile aux sages,
3. 1 4 1 5 9 2 6 5 3 5
Immortel Archiméde, Artiste, Ingénieur!
8 9 7 9
Que de ton jugement peut priser la valeur?
3 2 3 8 4 6 2 6
Pour moi ton problème eut de pareils avantages.
4 3 3 8 3 2 7 9

(London Academy)

Professor Berry also gives another jingle in German published originally by the *Frankfurter Zeitung*. Finally, and perhaps best of all, he says, is the one ascribed to Sir James Jeans: "How I want a drink,
3. 1 4 1 5
alcoholic of course, after the heavy chapters involving
9 2 6 5 3 5 8 9
quantum mechanics."
7 9

★ ★ ★

AMERICA'S FIRST railroad train to be fueled by oil made from coal was scheduled to glide out of the railroad yards at St. Louis and to swing North along the Mississippi on the fourth anniversary of VE Day on Sunday, May 8. Synthetic Diesel fuel for the special trip — some 1200 gallons — was produced at Louisiana, Missouri, as a part of the product of an initial 2-day run in the Coal Hydrogenation Plant dedicated there on the same day by the U. S. Bureau of Mines. The train ran on the Burlington line from St. Louis to Louisiana, Missouri, for the dedication ceremonies and then returned to St. Louis carrying the group of engineers and Department of the Interior officials attending the dedication.

INTERNAL-COMBUSTION engine designers spend a great deal of time in the design of combustion chambers, but frequently give little attention to the ignition system. So said H. B. Holthouse in a paper before the Oil and Gas Power Division of the ASME in Chicago on April 25. He described the Holthouse high-frequency system for gasoline engines, formed by adding certain circuit elements to the conventional ignition system. Mr. Holthouse said his purpose in presenting these data was primarily to call attention of all internal combustion engine designers to the possibility that this high-frequency ignition system might produce great improvements in the performance of oil engines as well as gasoline engines. The reasons are that it gives longer spark duration, prevents actual transfer of metal in the breaker contact points, the characteristics of the spark are of great assistance in promoting complete combustion; the sparkplugs clean themselves up and fouled plugs are eliminated; definite fuel economy is obtained and all this with no additional drain on the storage battery, the wattage input being no greater than with conventional ignition.

★ ★ ★

NEW DRY-ICE PLANT recently placed in operation on the West Coast is a good example of the oil and gas industry's utilization program. It came into existence in a round-about way. Because gas from the Santa Maria Field (Calif.) had an unsually high carbon-dioxide content, a plant was constructed to remove the carbon dioxide to make the gas available for commercial sale. A second plant was then built to convert the extracted carbon dioxide into dry ice.

★ ★ ★

POSSIBILITY that electrically-heated rubber may be successfully used for such industrial applications as freeing material frozen in chutes or bins, prevention of freezing in pipes, maintenance of temperature in hydraulic systems and the like, is envisioned by its manufacturer, B. F. Goodrich Co. The use of this electrically-heated rubber is being extended at present into various aircraft applications, strip heaters for moisture control on deep freeze units and so on. The electrically-heated rubber is constructed of resistance wires, insulated with fabric plies sandwiched between layers of rubber sheeting, with the parallel wires running the length of the rubber. It can be furnished in any reasonable size, shape or weight and for temperatures up to 300 F. Operation can be controlled by thermostats. The material can be applied by adhesion or placed on a metal background for bolting into permanent position. Each application must be engineered for mechanical and electrical conditions.

★ ★ ★

TO HELP BRIDGE the gap between the frontiers of pure science and the technology of engineering, a new division of engineering sciences is being created in the Faculty of Arts and Sciences at Harvard University. Professor Gordon M. Fair, present Dean of the Graduate School of Engineering, will become chairman of the new division. The University has also announced the appointment of Associate Professor Howard W. Emmons as Gordon McKay Professor of Engineering Science.

EMPLOYEE COUNSELING at Woodward Governor Co., Rockford, Ill., plays a rather important part in its famous design for working together. The program is quite extensive; starting with vocational guidance testing at the time a new member joins the organization, counseling services are available on legal, financial and health problems by specialists on the executive staff.

A very important advance in the company's counseling program was made recently when it secured the services of Dr. John Gordon, a well-known Rockford clergyman, to perform the duties of plant chaplain. Dr. Gordon is Life Pastor of the Second Congregational Church of Rockford. He will be available to Woodward members and their families as counsellor on personal and domestic problems, offering his moral and spiritual assistance wherever requested.

★ ★ ★

CARRYOVER PREVENTION of boiler water solids with steam is one of the most important problems encountered in steam generation. Various mechanical measures are taken to minimize steam contamination, such as the use of steam separators, steam washers, improved boiler design, and so on. Use of properly-designed chemical treatment has always been among the most useful measures of controlling steam impurities. But, in the last few years, truly remarkable strides have been made in the development of highly effective anti-foam agents. The results obtained with some of these newer materials have been almost startling.

In a detailed and authoritative article on this subject in the March 1949 issue of *The Betz Indicator* the various mechanical and chemical influences on carryover are explained and details are given on the factors and causes of foaming and of anti-foaming action. Types of anti-foam agents are discussed and case histories recounted showing some of the results obtained with them. Under today's conditions, the report concludes, with a variety of highly effective anti-foam agents available, internal chemical treatment of the boiler feedwater is not complete unless anti-foam properties are incorporated as a matter of course.

While every plant may not be troubled with a contaminated make-up water, the incorporation of anti-foam properties act as insurance. In addition, it permits each plant to operate at minimum blowdown consistent with the maintenance of clean boiler heating surfaces. Heat loss through blowdown is thereby maintained at its minimum value.

★ ★ ★

INTERNATIONAL EXCHANGE of technical know-how, so strongly advocated by President Truman in his inaugural address, received strong support from James S. Thompson in a paper "Technical Literature, Its Responsibility As An International Influence," delivered before the World Engineering Conference at Cairo, Egypt in March. Mr. Thompson points to the exchange of technical information, without any ideological connotation, as a dynamic vehicle in knitting together all peoples of this war-weary world. Postwar interest in engineering, education, science, industrialization, and in the interchange of information generally, has been continuously sustained on an international level, says Mr. Thompson. We ourselves can bear witness to this from the steadily-increasing number of inquiries for information we receive from abroad. Following World War II, export of United States technical literature has far surpassed records of pre-war years.

MANY POWER ENGINEERS, burners of large quantities of bituminous coal in their power plant boilers, are much interested personally in the burning of small amounts of fuel for heating their homes; and, in particular, have been interested in methods of anthracite coal burning for heating the average house. Such engineers would do well to obtain a copy of the pamphlet "Selecting Automatic Anthracite Heating Equipment for the Average House," by Norman C. Curtin. This publication, a reprint of an article in *Progressive Architecture*, gives many technical details in determining heater requirements, chimney design, design of fuel bins and ash disposal, and cost factors in heating with various fuels. The last part of the publication is devoted to the technical details of the Anthratube, described in *Power Plant Engineering* several years ago. This compact anthracite-burning stoker can be arranged for automatic operation and its controls are discussed in detail. The Anthracite Institute, Wilkes-Barre, Pa., will gladly send you a copy of the bulletin on request.

★ ★ ★

YOU HAVE PROBABLY seen in your local photographic supply store the new Polaroid Land camera that has just been made commercially available. (Land is the inventor's name; it works on water, too) This is the camera in which, after making an exposure, you withdraw a finished print in about a minute or less, no other processing being necessary.

Full details of the principle and operation of this camera were given on page 181 and 183 of the August 1947 issue of *Power Plant Engineering*, shortly after the process was announced. Since that time, the commercial camera, a little larger than the old 3-A Kodak and giving a picture approximately 3 inches by 4 inches in size has been developed.

What this new camera will do to the existing photographic field is, at this moment, anybody's guess.

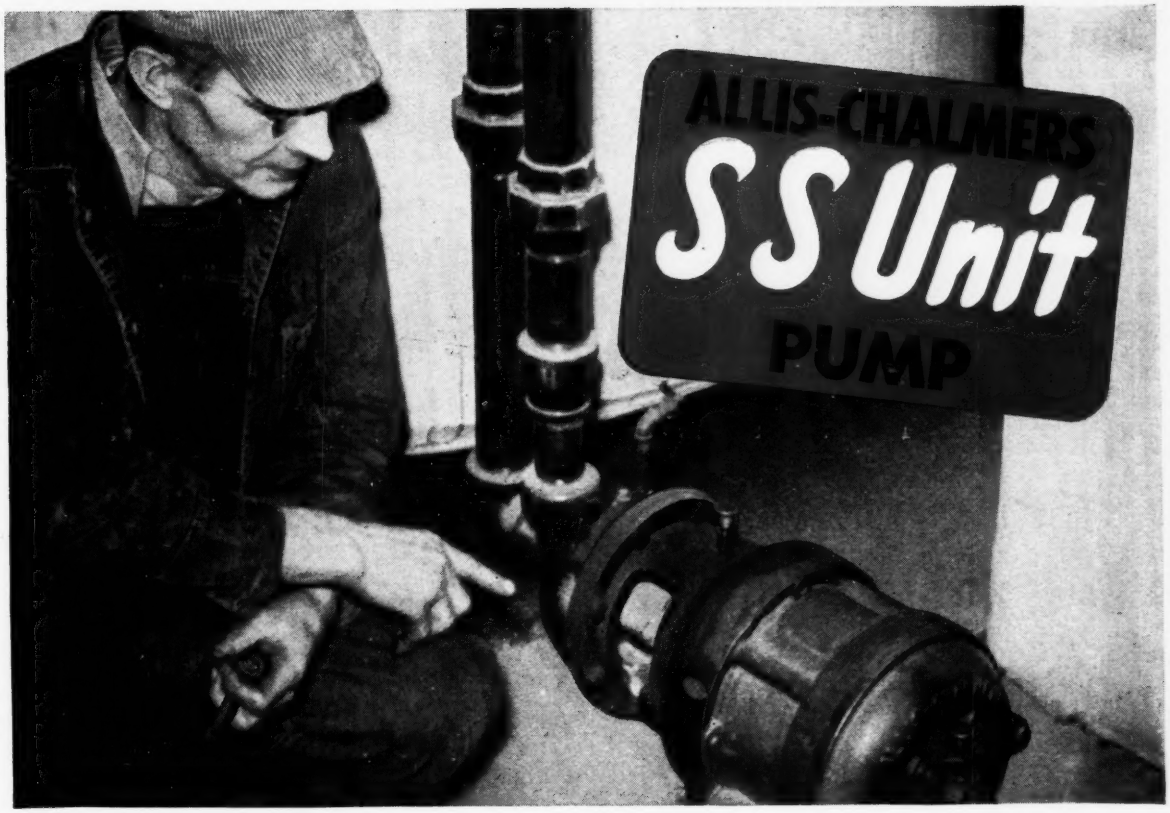
★ ★ ★

IN ENGINEERING, on the whole, there does not seem to be too much of what people consider a harmful emphasis on the past. Engineers as a class are always looking forward and it has been our experience that the following diatribe by Dr. George W. Crane, in his syndicated column in the *Chicago Daily News*, does not fit more than an insignificant handful of engineering instructors. But if it is true that the general public, outside the engineering, medical and a few other professions, are being taught by this type of instructor, then it is no wonder that we have in this country a "cultural lag" of anywhere from 10 to 20 years.

But Dr. Crane, criticizing college professors, says "I regret to confess that the 'average' professor is a second-rater and not the broad-visioned, dynamic personality we should have teaching our youth.

"Too many current professors are what I term 'tombstone dusters' and 'epitaph polishers.'

"They are intellectual archeologists, digging into archaic ruins largely to gloat over the fragments of obsolete dynasties. Their students then graduate backwards into life, with their eyes turned on the past instead of upon the present and future . . . Mental journeys through antiquity are justifiable only if they contribute something of current value to our own generation." Is this criticism justified? Are too many of our teachers like that or are they such a minority that we don't have to worry about them?



7 Years ... NO REPAIRS!

SS Unit Pump on 24 hour, intermittent 7 day duty in power plant gives equivalent of 20 years normal service with *no* repair cost, *no* lost time

SINCE EARLY 1942 this SS Unit pump has been pumping water for the water seal to turbines in the Manitowoc, Wisconsin power plant. Never has it failed to operate perfectly; outside of normal repacking, not one cent spent on repair!

Here's *proof* that the extra-strong design, extra-heavy construction and extra-quality manufacture of Allis-Chalmers pumps give you dependable performance and low pumping costs.

Compare SS Unit features with any similar pump. Notice how SS Unit is compact, yet open for easy maintenance. Motor and pump are solidly bolted together using the same shaft. This design holds alignment rigidly . . . reduces vibration . . . cuts wear and tear. Every A-C pump is tested at the factory. Full rated efficiency and output are *guaranteed*.

SS Unit is one of many Allis-Chalmers pumps for industrial service. For complete information, see your Allis-Chalmers Authorized Dealer or Sales Office, or write for Bulletin 52B6059E. Also in Sweet's.

SS Unit, Texrope and Vari-Pitch are Allis-Chalmers trademarks A-2692

Sold . . .
Applied . . .
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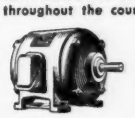
by Allis-Chalmers Authorized Dealers, Certified Service Shops and Sales Offices throughout the country.



MOTORS — ½ to 25,000 hp and up All types

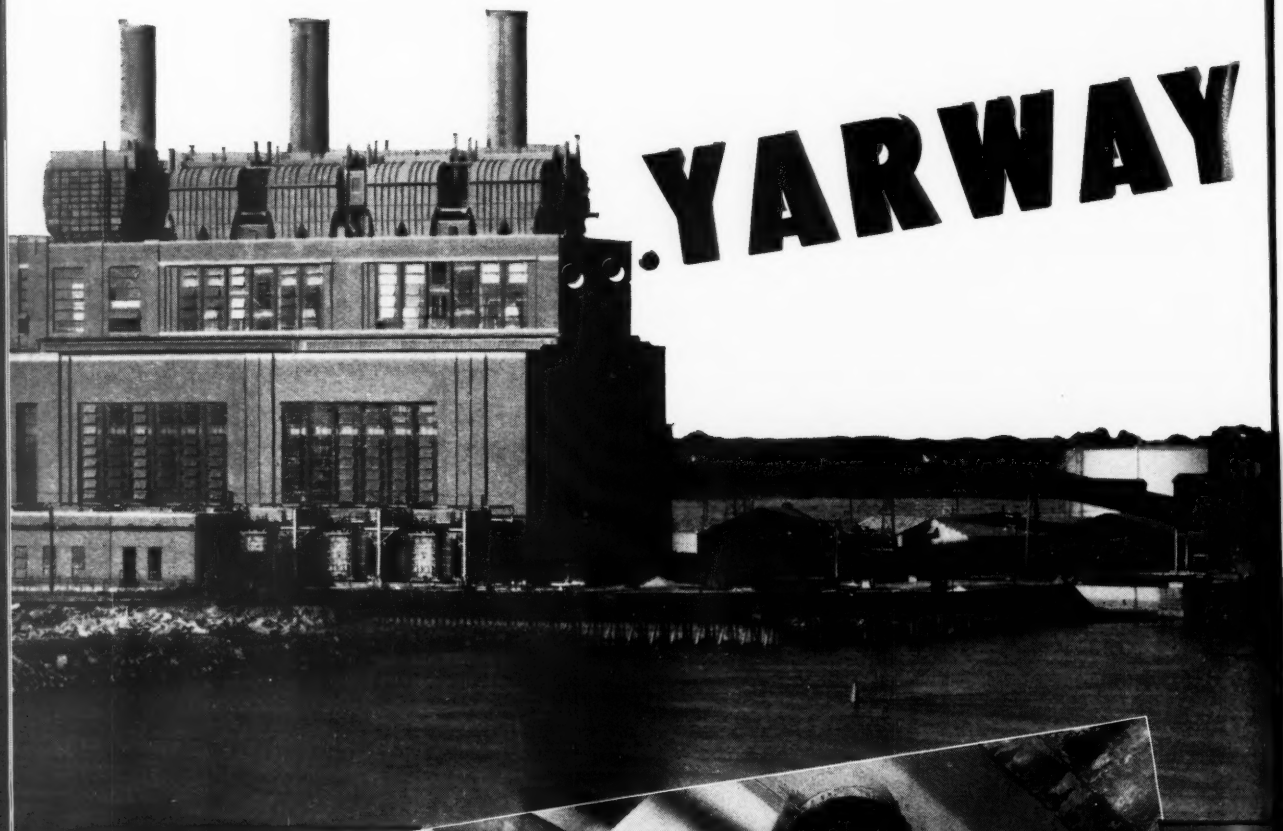
CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

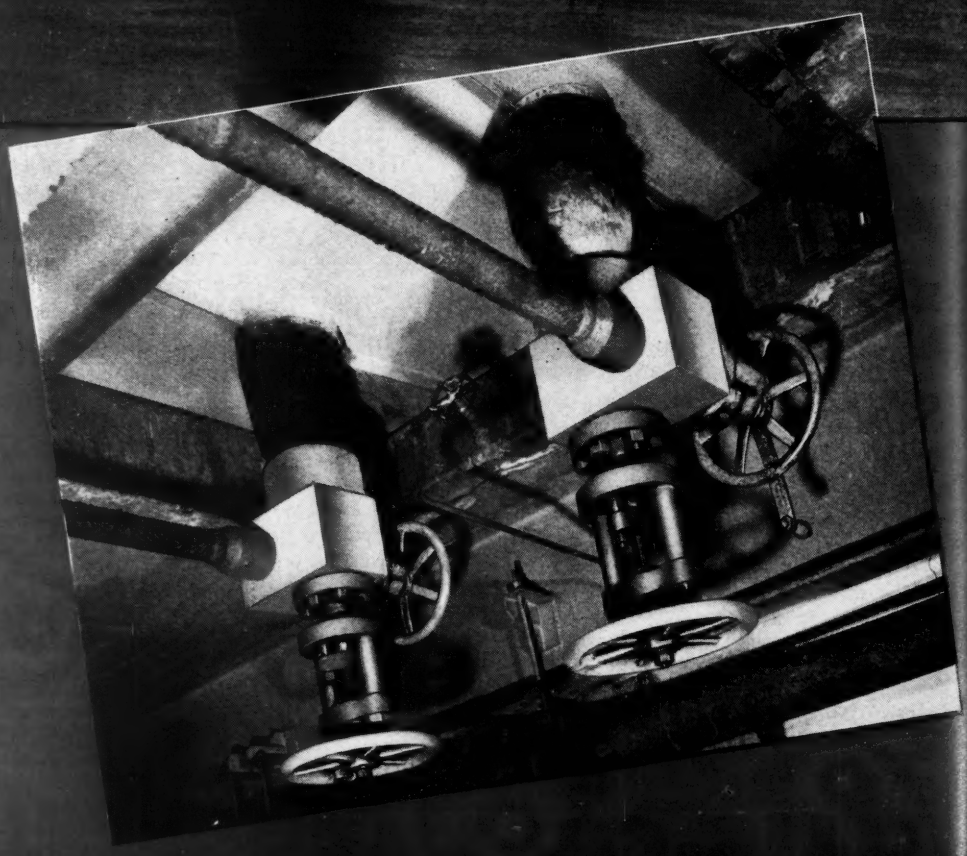
TEXROPE — Belts in all sizes and sections, standard and Vari-Pitch sheaves, speed changers.

ALLIS-CHALMERS, 953A SO. 70 ST.
MILWAUKEE, WIS.

ALLIS-CHALMERS

Public Service (N.J.) *Chooses* YARWAY





Burlington, N. J., Station of the Public Service Electric and Gas Company. Four boilers at this plant, and two at Public Service's Marion Station are each equipped with two Yarway Unit Tandems. Steam pressure boiler 1350 psi, turbine 1250 psi. Temperature 950° F. Output, each boiler, 550,000 lbs per hour; high pressure turbines, 125,000 KW each.

YARWAY BLOW-OFF VALVES

UNIT TANDEMS

FOR HIGH PRESSURE BLOW-DOWN SERVICE

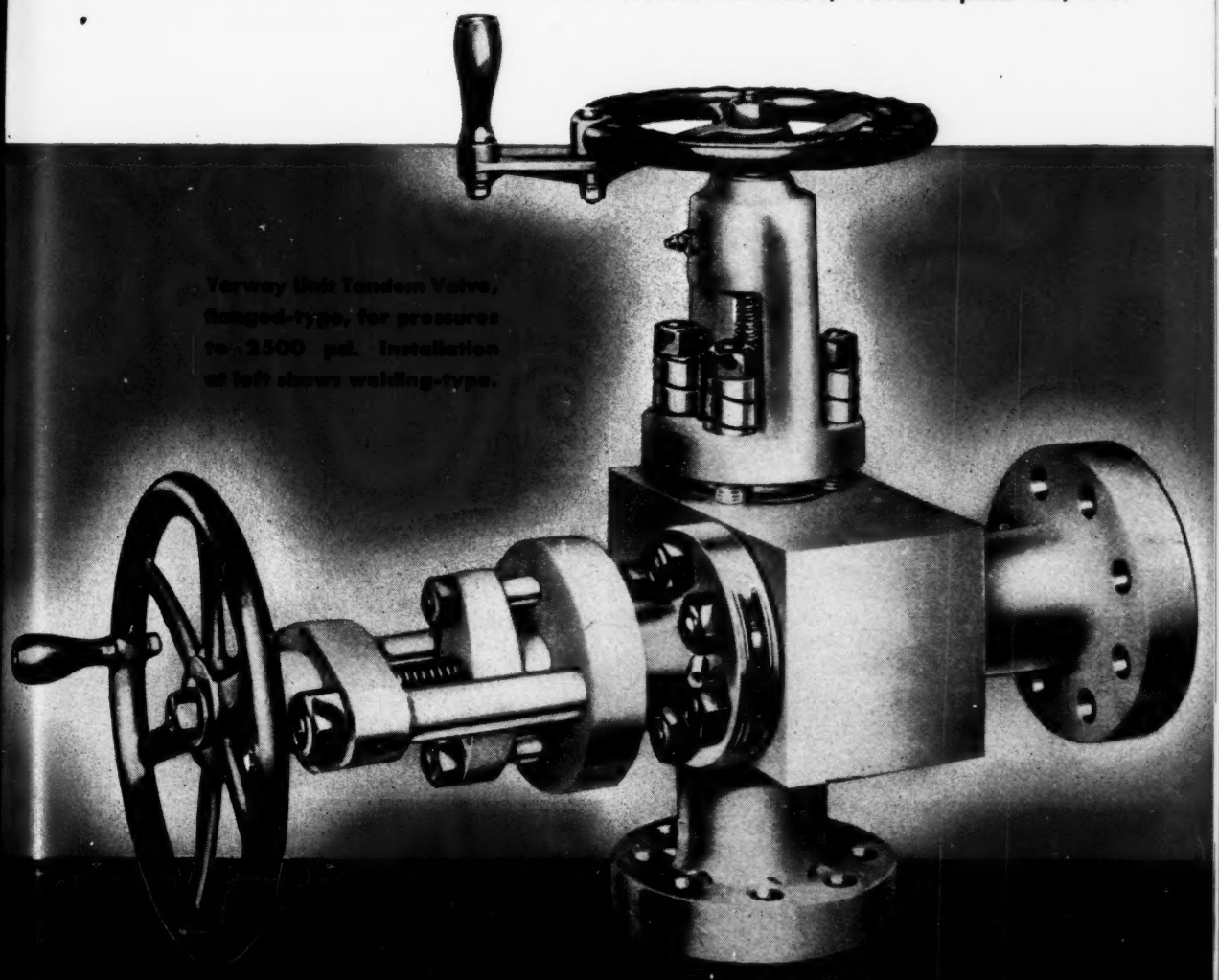
Why has the Public Service Electric and Gas Company of New Jersey, like so many other leading utilities, selected Yarway Unit Tandem Blow-Off Valves for their high pressure boilers? The answer is simple—*proved performance.*

Yarway Unit Tandems have proved themselves unequalled in service throughout all industries on pressures from 400 to 2500 psi. This tandem is a combination of the Yarway Hard-Seat* Valve (next to boiler for blowing) and the famous Yarway Seatless Valve (for sealing)—both contained in a one-piece forged steel body. This rugged construction eliminates the interconnecting flanges, bolts and gaskets required in bolted tandem designs, making a trim, compact unit.

Nearly 40 years of laboratory and field experience concentrated on blow-off valve requirements, makes Yarway a logical source of supply for your next blow-off valves. Write for Catalog B-432 for pressures up to 2500 psi . . . Catalog B-424 for lower pressures.

** Seats furnished either separate or integral.*

YARNALL-WARING COMPANY • 114 Mermaid Avenue, Philadelphia 18, Pa.



Yarway Unit Tandem Valve, flanged-type, for pressures to 2500 psi. Installation at left shows welding-type.

2,800,000 Lb Per Hr of Controlled Superheated Steam

Produced in One Station by Foster Wheeler Twin Furnace Steam Generators

Slag-free Operation

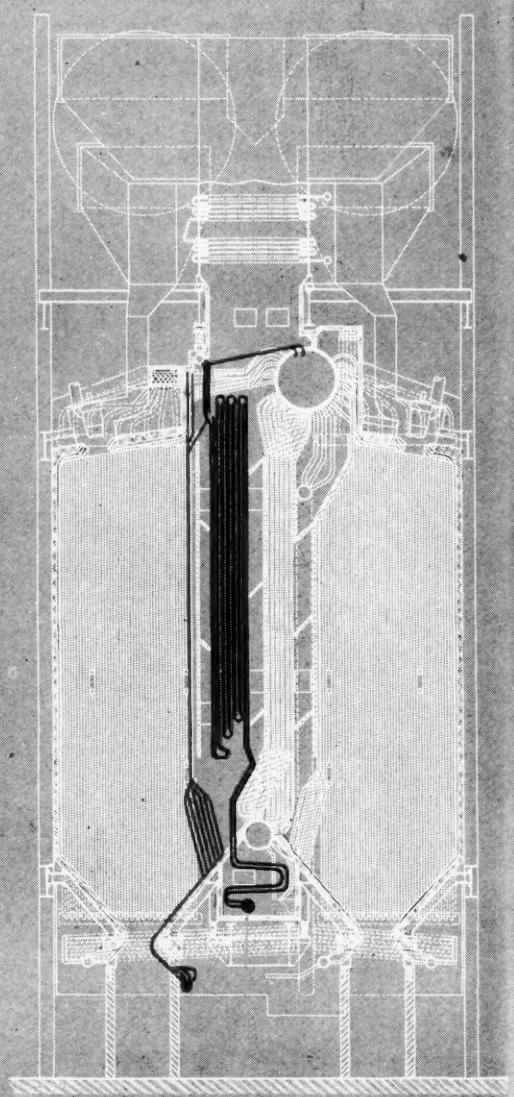
Furnace exit gas temperatures of high capacity, high pressure, high steam temperature units are established by the slagging characteristics of the fuel fired. The Twin Furnace design provides approximately 30% more cooling surface than a single furnace unit having similar furnace proportions.

Controlled Final Steam Temperature

By judicious proportioning of the surface of the radiant superheater located in one furnace and the convection superheater, a desirable flat characteristic steam temperature curve may be attained. Further control is obtainable by differentially firing the two furnaces thus stabilizing steam conditions for optimum turbine efficiency over the widest possible operating range.

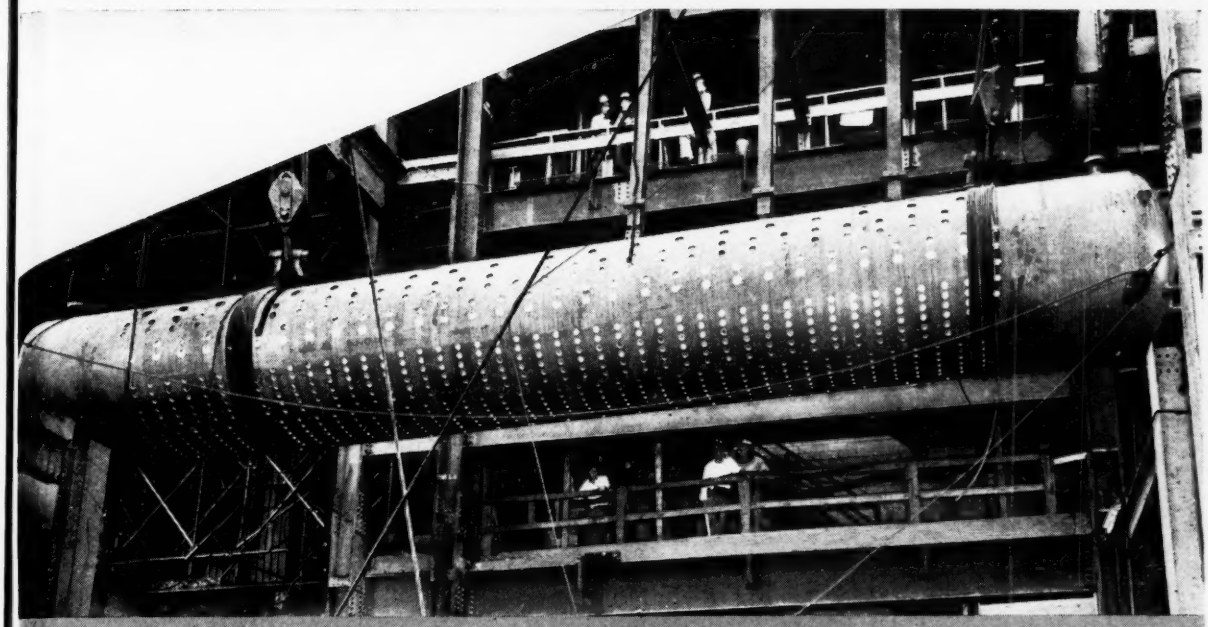
Compact Design

Substantial saving in building space is achieved through the use of smaller permissible furnace volumes with increased cooled wall area distributed in two furnaces and by compact arrangement of all component parts of the unit.

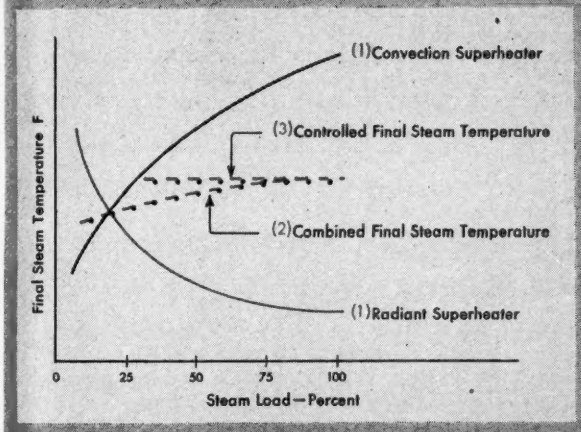


Duquesne Light Company
Phillips Power Station
Pittsburgh, Pennsylvania

Steam capacity	600,000 lb per hr
Superheat control range	270,000 to 600,000 lb per hr
Pressure superheater outlet	900 psi
Final steam temperature	900 F
Bituminous Coal Pulverized in FW Ball Mills	



An upper steam drum being placed in position at Unit No. 2 of the Phillips Power Station of the Duquesne Light Company.



Curves showing final steam temperature

(1) Convection and radiant superheaters operating independently

(2) Twin Furnace combination radiant and convection superheater

(3) Controlled differential firing at lower partial loads, minimizing the need for special temperature control equipment.

A total of 5 Twin Furnace steam generators—designed, engineered, and constructed by Foster Wheeler—will be installed at the Phillips Power Station of the Duquesne Light Company which serves a large area in and around Pittsburgh, Pa. Two are already in service and three are on the way. This station, which will generate 237,000 kilowatts when completed, is part of a system covering a territory populated by some 1,500,000 persons.

Growing preference for this ideally balanced design is evidenced by the fact that other large utilities are now using Foster Wheeler Twin Furnace steam generators. The Twin Furnace arrangement with combination radiant and convection superheater permits constant final steam temperature through exceptionally wide load ranges.

FOSTER WHEELER CORPORATION **165 BROADWAY, NEW YORK 6, N. Y.**

FOSTER WHEELER

Here's evidence of safer tu

WHY will Nonpareil Turbine Oil assure more reliable operation of your turbines? The answer is revealed by this 21-year record of "Nonpareil" in a power generating station, owned and operated by the Carnegie-Illinois Steel Corporation.

"Nonpareil" was put into the 30,000 KW General Electric turbine in 1927, and into the two 15,000 KW Allis-Chalmers units the next year. In over 21 years' operation on "Nonpareil", there have been no oil replacements, no cleaning of oil systems, no oil removed for treating. Neutralization numbers of all fills of oil have remained below 0.08 mg. KOH/gm. No outages have been enforced by oil troubles or oil-system maintenance.

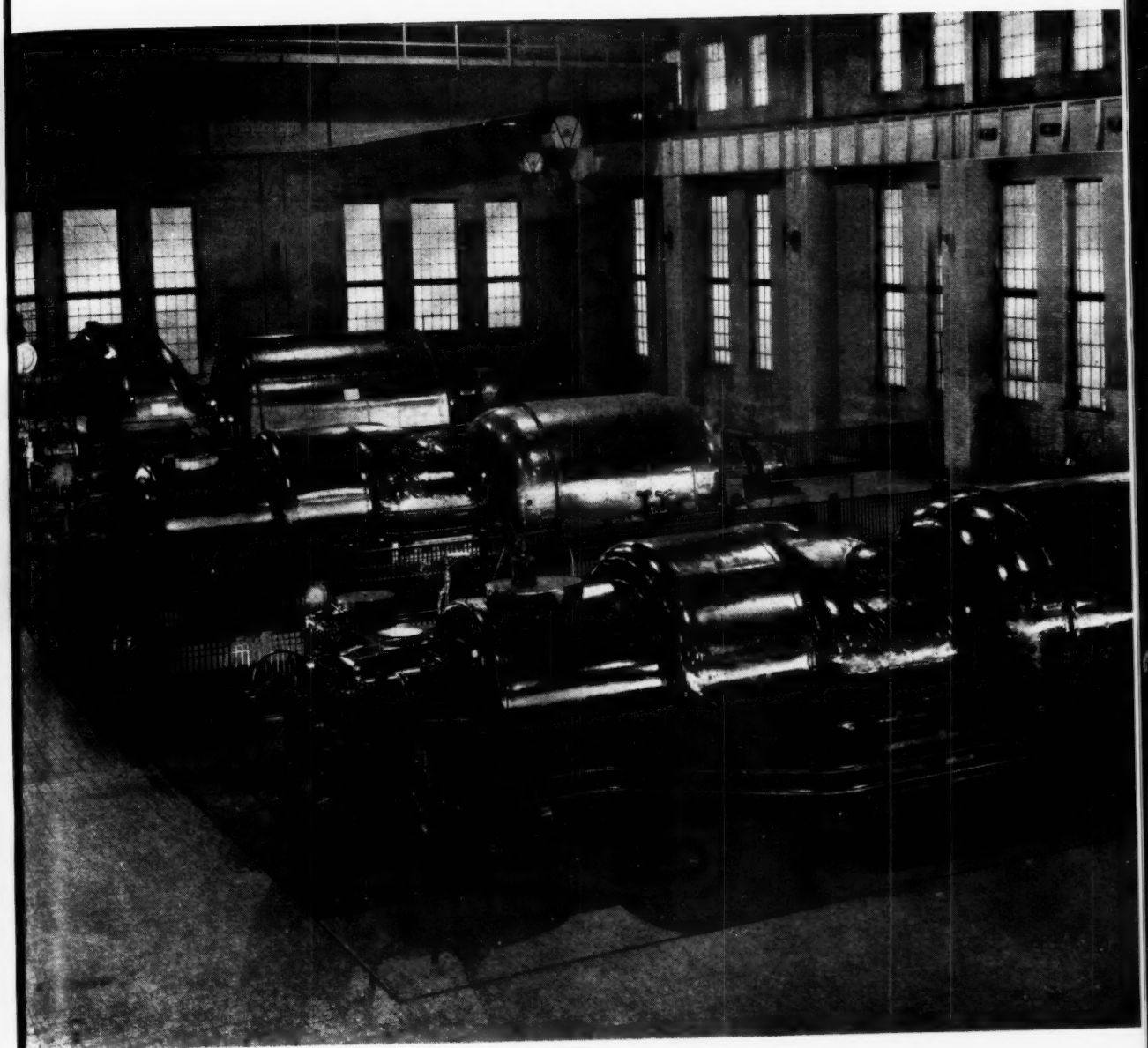
Such performance records as this furnish ample evidence that "Nonpareil" lives up to its guarantee that *it will not increase in acidity above a neutralization number of 0.15 MG. KOH/GM.* This guarantee of "Nonpareil" is your insurance against outages caused by oil failure.

You can end acidity trouble and oil maintenance once and for all, by shifting to Nonpareil Turbine Oil. If your plant is located in the Midwest, write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois, to secure the services of the Standard Oil Lubrication Engineer nearest you.

NONPAREIL
Turbine Oil
"Will outlast your turbine"

STANDARD **STANDARD OIL COMPANY (INDIANA)** ST

turbine operation



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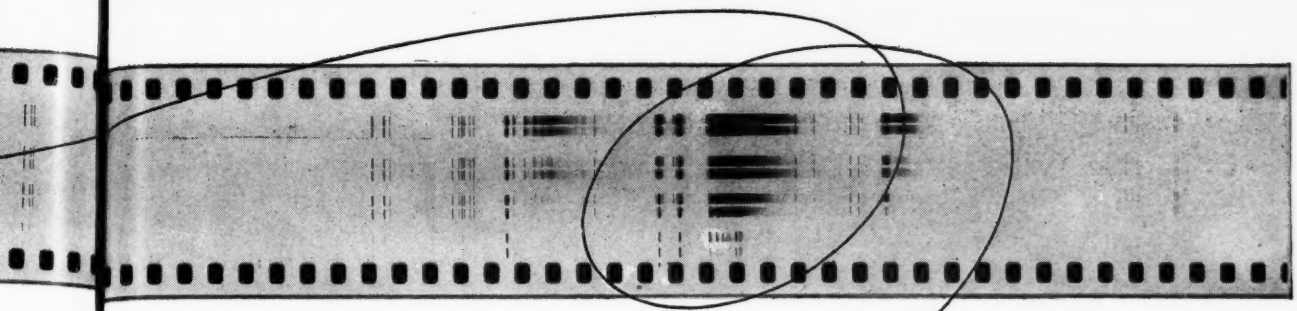
Guide Lines

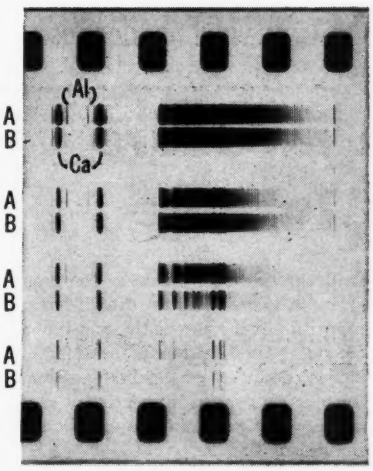


to Boiler Conditions

Some of the most significant clues to what is happening in a boiler are obtained by analyzing boiler deposits. To analyze these complex deposits as rapidly and accurately as possible, Hall Laboratories uses not only the traditional chemical methods but also employs such instruments as the petrographic microscope, the X-ray and the spectrograph.

This last instrument, which is becoming of increasing value in the water field, utilizes light as a means of analysis. When an atom of an element is excited by heat or electrical discharge, it gives off light of various wave lengths or colors. The pattern of wave lengths is different for each element. In spectrographic analysis, the specimen to be studied is burned in a carbon arc. The light radiated by the arc is "sorted out" by a diffraction grating or prism into its various wave lengths, which are then recorded photographically as a series of lines. From the position and intensity of the lines, the operator can not only tell what elements are present in the sample, but can determine their proportions with considerable accuracy.

Spectrographic analysis is particularly useful in detecting the metallic elements. Suppose excessive quantities of an adherent deposit have been found in a boiler. A rapid check with the spectrograph, requiring less than half an hour, may definitely establish the presence of considerable aluminum, which tends to form troublesome boiler scales.



Spectrogram of sludges containing largely calcium and magnesium compounds: A—Aluminum content significant—should be determined. B—Aluminum content negligible. NOTE: Bottom pair too weak to show aluminum lines.

On the other hand, the spectrographic analysis may prove that aluminum is present only in negligible amounts, in which case some other factor is responsible for the difficulty. In either case, the relative abundance of aluminum is determined spectrographically in a few minutes, while chemical analysis would give this information only after a considerably longer time.

The ability of the spectrograph to detect and identify metallic elements is particularly valuable in analyzing deposits containing unusual constituents. In one case, for example, spectrographic analysis quickly revealed the presence of an appreciable amount of strontium in a deposit, and also helped trace the source of the strontium to the raw water supply.

Spectrographic analysis is only one of the many methods used by Hall Laboratories in the course of getting the fullest possible information about your problem—and thoroughness in this respect is only one of the reasons why so many plants, large and small, use Hall Service.

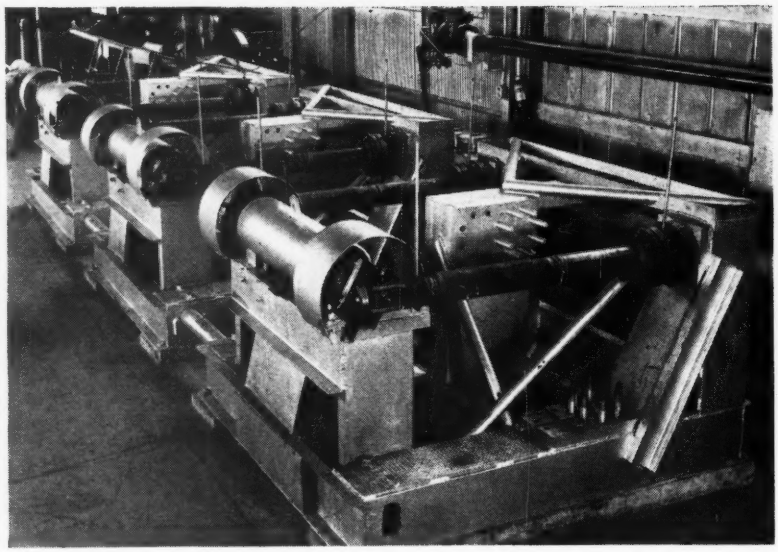
Hall Laboratories, Inc., Hagan Building, Pittsburgh 30, Pa.

HALL LABORATORIES, INC.

(A Subsidiary of Hagan Corporation)

CONSULTANTS ON
INDUSTRIAL WATER TREATMENT
HALL SYSTEM OF BOILER WATER CONDITIONING
INDUSTRIAL WASTE RECOVERY AND DISPOSAL

HAGAN HALL BUROMIN CALGON



Strength through Design in Tube-Turn welding flanges

Taking the measure of piping fatigue

PIPE lines are *live, dynamic* members of a piping system. They *breathe* with changes in temperature and pressure. And the danger of fatigue failure from pressure shock, thermal shock, and cyclic conditions is ever-present.

More precise information was needed on this subject. So, Tube Turns research engineers set out to get the answers. For the purpose, they designed and built a unique cyclic testing machine to handle full-size piping assemblies under a wide range of temperature, pressure, and corrosive conditions. And on this torture rack they subjected flanged assemblies to reverse bending tests carried on to ultimate failure. Information revealed forms the basis of new designs for greater strength in Tube-Turn welding flanges.

Other piping assemblies, too—welding elbows, mitre bends, manufactured and fabricated tees, pipe bends—have been subjected to punishment more severe than any they would probably face in normal service.

And this perpetual search for greater strength through better design has paid off in the form of realistic, non-theoretical facts providing a sound basis for Tube Turns' manufacturing policies—facts important to anyone interested in getting his money's worth in long life from piping installations.

Tube Turns' research and development organization, finest in the welding fittings industry, is constantly striving for the improvement of present products, the development of new ones. Notable among their recent achievements have been the design of a new type welding tee and the development of aluminum welding flanges.

Ask to be put on the mailing list for Tube Turns' technical periodical, *Piping Engineering*. Paper 6.01, for instance, deals extensively with standard steel flanges. Others give you research findings and additional working information pertaining to piping not generally available in convenient form.

TUBE-TURN

tt

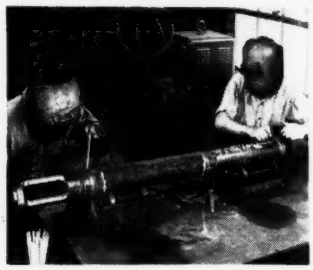
WELDING FITTINGS AND FLANGES

TUBE TURNS, INC.

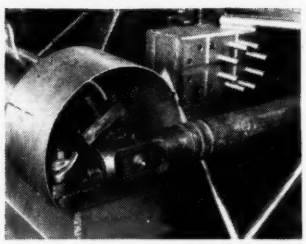
234 East Broadway, Dept. I, Louisville 1, Kentucky

District Offices at New York, Philadelphia, Pittsburgh, Chicago, Houston, Tulsa, San Francisco, Los Angeles

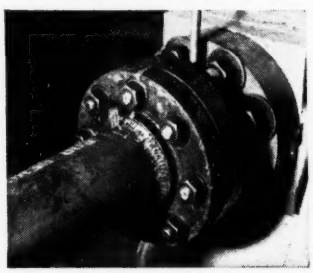
TYPICAL FLANGE ASSEMBLY TESTS



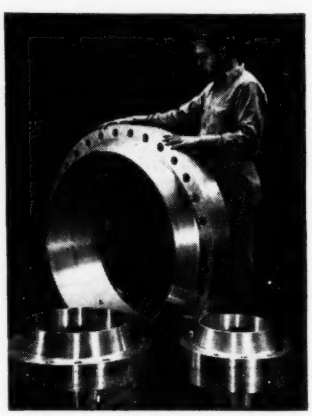
Assemblies were of 4-inch nominal size with 300 pound forged steel flanges and standard weight pipe.



Eccentric crank arm produces up-and-down movement which creates a cyclic bending moment on flange or fitting at opposite end of assembly.



Water spurts from crack in test specimen. Almost invariably, failure occurred in the pipe adjacent to the flange.



Aluminum welding flanges . . . another Tube Turns first! Available in a wide range of types and sizes.

RAINS PACKING *Eliminates* SEAL & LANTERN RINGS

Rains Packing is similar to a self-lubricated bearing extending the entire length of the stuffing box. A minimum of friction and a tighter seal maintain vacuum without seal or lantern rings. Pumps keep their prime and give greater output. There is no leakage. With new pumps Rains Packing eliminates all need for seal or lantern rings and does away with the expense for piping in fresh water.

A lead-based, anti-friction metal is used that will withstand temperatures well over 1200° Fahr. (temperature tests by University of California). Proportionate with the metal units are materials of a heat-resisting nature to substitute for the wood units of the standard packing . . . thus giving resiliency to the packing and at the same time prevents the packing from forming a solid under excessive pressure. Both materials being treated separately with special lubricants and graphite depending upon the job. Withstands all pressures and temperatures.

Caustic
Acids (state kind)
Gas and Oil (petroleum solvents)
Alcohol (pure and mixed)
Paint Pump
Food Products
Below zero temperatures
special requirements (made to order)

Specially treated so that the dissolving action of the liquid does not affect the packing. The packings are broken in with the pumps running idle; producing a sealed-in lubricated bearing formation, thus protecting the shaft from the corrosive effect of the material handled.

RAINS STANDARD PACKING is used on all the ordinary services found in the average industrial or power plant . . . on either reciprocating or rotary motion rods, stems and shafts . . . on pressures to 10,000 pounds; temperatures to 400° Fahr.

On pumps . . . hot and cold water, brine, asphalt, creosote, sewage, and other services.
All saturated steam services
Hydro-electric equipment
Air compressors and pumps
Presses, accumulators, hydraulic pumps
Refrigeration equipment
Valves

PROOF

On the primary control valves of a 36,000 KW, G.E. turbine, 250 pounds pressure, 625° Fahr., total temperature, RAINS SUPERHEAT PACKING outlasted the leading conventional types of packing 18 times. One engineer states: "Complete satisfaction with the various packings used in the past on 550 pounds pressure has not been attained . . . with RAINS SUPERHEAT PACKING there was no leaking and no binding.*

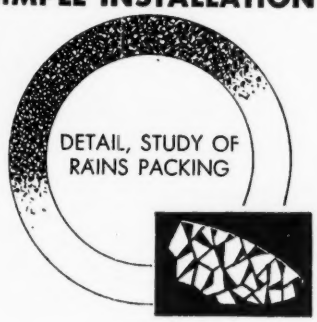
PROOF

Hot Sulphuric Acid Pumps at large paper mill packed with RAINS SULPHURIC ACID PACKING have given 26 months of service without maintenance costs. Conventional type packings lasted from a few weeks to 4 months and were always in danger of suddenly disintegrating and spilling acid over bearings, causing $200 to $300 damage as well as expensive man hours in repair work.*

PROOF

Boiler feed pump service is considered one of the hardest of the ordinary services to hold because of the drying out of conventional packings due to heat and effect of boiler compounds. THREE OR FOUR MONTHS IS AVERAGE LIFE OF CONVENTIONAL PACKINGS. RAINS PACKING ON THE SAME PUMPS IS STILL IN OPERATION AFTER FIVE YEARS OF SERVICE . . . same rods and shafts, same packing.*

SIMPLE INSTALLATION



RAINS PACKINGS are broken in to form a self-lubricated, bearing-like wearing surface next to the rod or shaft.

Lantern or seal rings are removed. .

If openings in bottom of box are large, metal choke rings are recommended. Cut rings from coil and tamp each ring into box separately with wooden stick and hammer until completely full. Tighten gland. Add another ring if possible. Keep tightening gland at regular intervals, never permitting packing to leak. The packing will heat, but keep tightening. After it is broken in and the bearing is established to the point of a frictionless operation, it will cool off and run much cooler than conventional packings.

*AFTER 30 DAYS, TEST PUMP FOR INCREASED OUTPUT by comparison with previous packings used.

Distributors Located In Principal U.S. and Canadian Cities.

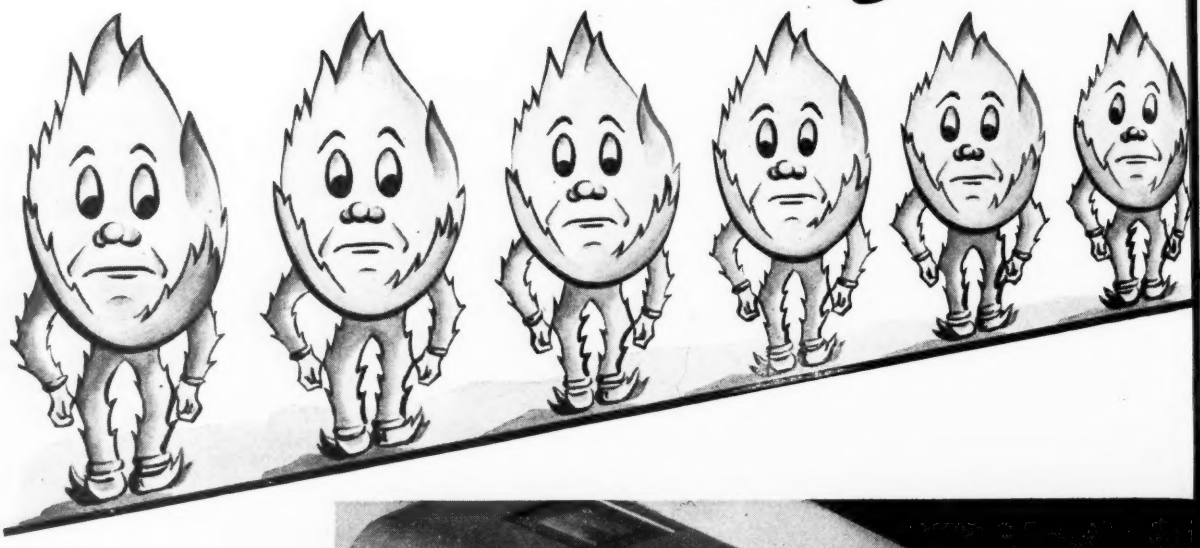
RAINS **WOOD-METAL PACKINGS**

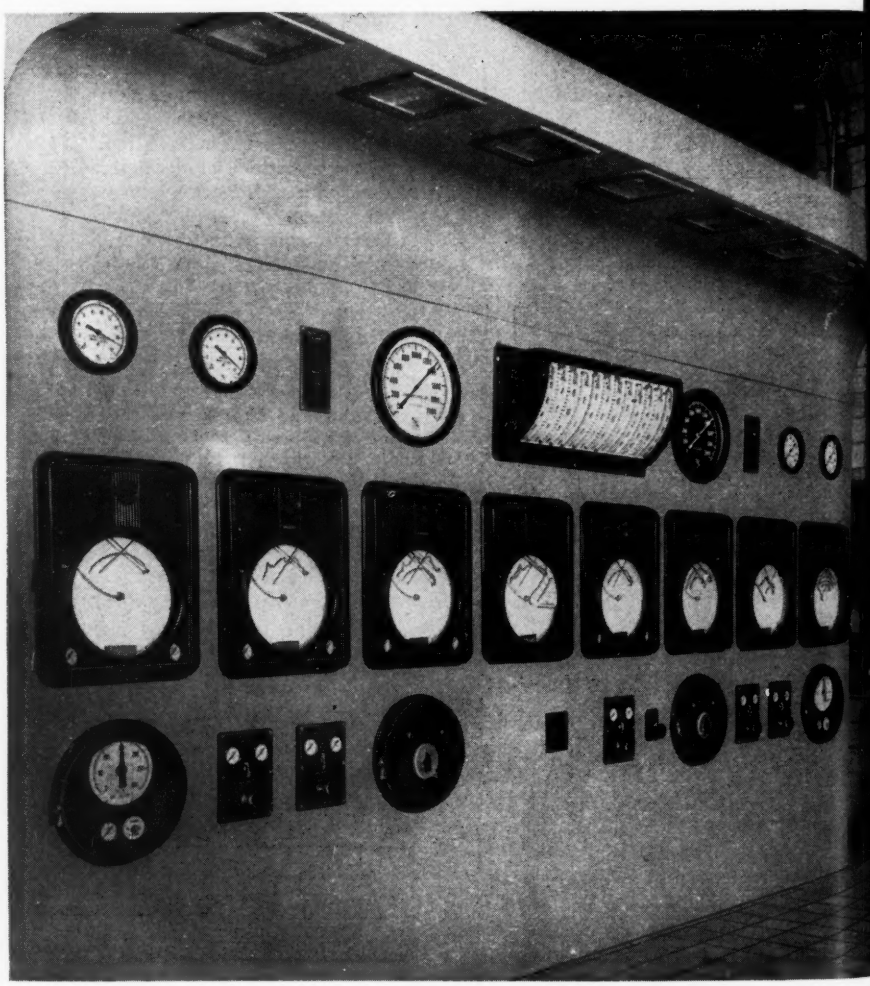
904 W. Broadway, Spokane, Washington, U. S. A.

*PROOF on any type of pump will be furnished on request.

When ordering new Equipment . . . Specify RAINS PACKINGS

Keeping Btu's



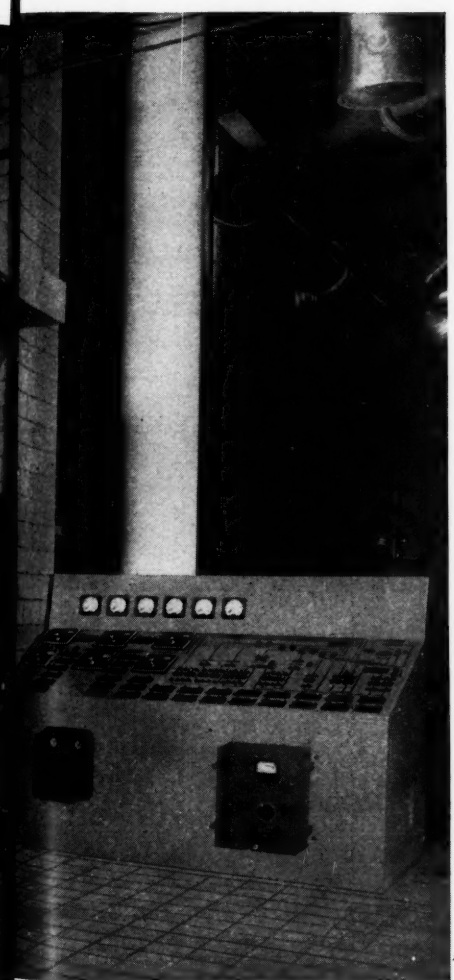


Bailey Boiler Control Panels for 200,000 lb per hour capacity, 880 psi, 900° F pulverized coal-fired boiler at the Hudson Steam Plant of Rockland Light and Power Company, Tomkins Cove, New York. All

Branches in: Atlanta, Boston, Buffalo, Charlotte, Chicago, Cincinnati, Denver, Detroit, Houston, Kansas City, Los Angeles,

IN LINE

at Tomkins Cove



Boiler Controls are co-ordinated to insure efficient handling of the heat energy released in combustion.

● Optimum conditions in routine operation are provided for at the Hudson Steam Plant of Rockland Light and Power Company. This new station at Tomkins Cove, New York, keeps Btu's in line with a complete installation of Bailey Boiler Controls, all co-ordinated to work as a team in directing the efficient use of heat energy.

The installation includes:

Bailey Combustion Control

Bailey Three-element Feed Water Control

Bailey Steam Temperature Control

Bailey Coal-Air Temperature Control

Bailey Three-element Condensate Control.

It's easy to keep Btu's in line with co-ordinated controls engineered to fit your plant.

Call your local Bailey Engineer for recommendations on how meters and controls can help you to get more useable heat energy from your fuels.

A-108-2

BAILEY METER COMPANY

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BAILEY METER COMPANY LIMITED, MONTREAL, CANADA

BAILEY METERS

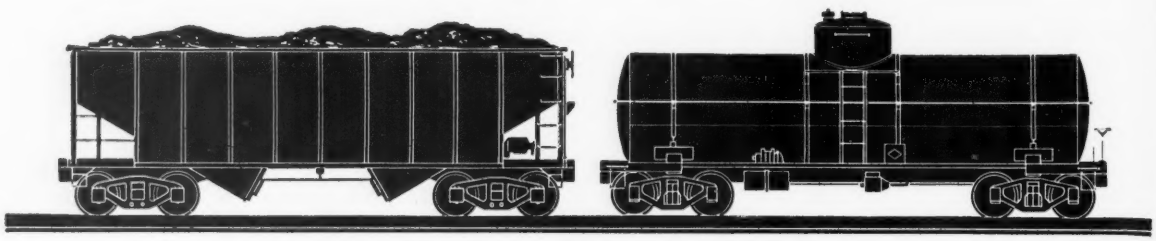
Controls for Steam Plants

COMBUSTION · FEED WATER · TEMPERATURE

PRESSURE · LIQUID LEVEL · FEED PUMPS

Milwaukee, New Orleans, New York, Philadelphia, Pittsburgh, St. Louis, St. Paul, San Francisco, Schenectady, Seattle.

NO MATTER HOW FUEL COSTS FLUCTUATE



You're Sure Of Combustion Economy By Using...

ENCO

OIL BURNERS WITH COAL FIRED UNITS

YOU CAN ALWAYS TAKE ADVANTAGE of the best market price of fuel when your power plant is equipped with Enco Oil Burners in combination with coal burning units. You can readily change from coal to oil — and back to coal. Comparative BTU costs and fuel availability are the only governing factors.

With Pulverized Coal Burners, you can use either Enco Mechanical or Steam Atomizers for ignition and entire load range because both oil and coal are finely divided fuels that burn in suspension. Bulletin OB-PC contains complete details on use of Enco Oil Burners with Pulverized Coal. A copy will be sent on request.

With Stoker or Hand Fired Units, this same combination can be made for partial or full loads, either for temporary or permanent application. Complete information on installations of this type will be sent on request.

BULLETIN OB-PC GIVES FULL INFORMATION ON THESE ENCO UNITS

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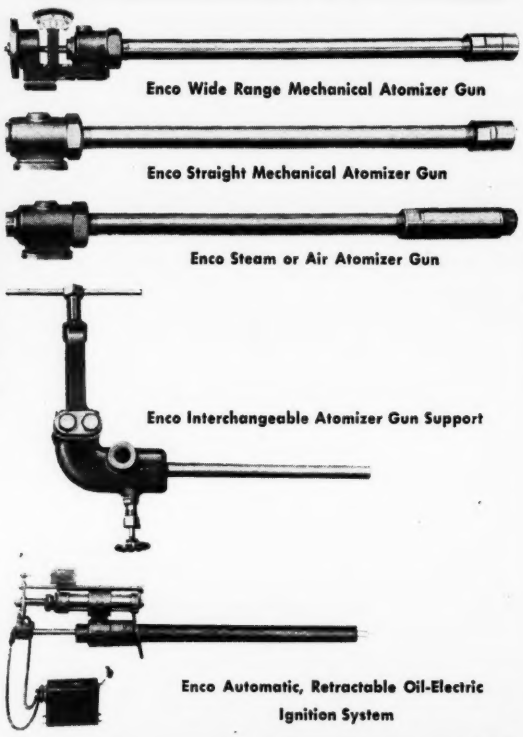
ENCO INTERCHANGEABLE FUEL OIL ATOMIZERS



Enco Wide Range Mechanical Atomizer Gun

Enco Straight Mechanical Atomizer Gun

Enco Steam or Air Atomizer Gun

Enco Interchangeable Atomizer Gun Support

Enco Automatic, Retractable Oil-Electric Ignition System

EC-478

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STOP BOILER FOAMING and CARRYOVER WITH
DREW Antifoam D
Without DREW ANTIFOAM D
Note variation in steam temperatures due to carryover
With DREW ANTIFOAM D
Note constant steam temperatures no carryover
PREVENT DEPOSITS IN THE FEEDWATER SYSTEM WITH
DREW Organic STABILIZERS
PREVENT BOILER TUBE FAILURES OF THIS TYPE WITH—
DREW Organic SLUDGE CONDITIONERS
Adherent sludge and suspended matter will result in the failure of boiler tubes in the same manner as scale . . . by causing the overheating of tube metal. Generally accepted procedures for the prevention of scale involve proper chemical treatment and control. Sludge is formed in these processes. Drew Organic Sludge Conditioners, used in conjunction with proper chemical treatment, prevent the adherence of sludge and suspended matter to tube metal and eliminate failures of this kind.
A Drew Engineer will be glad to call on you to discuss sludge and any other water problems which you may have. No obligation
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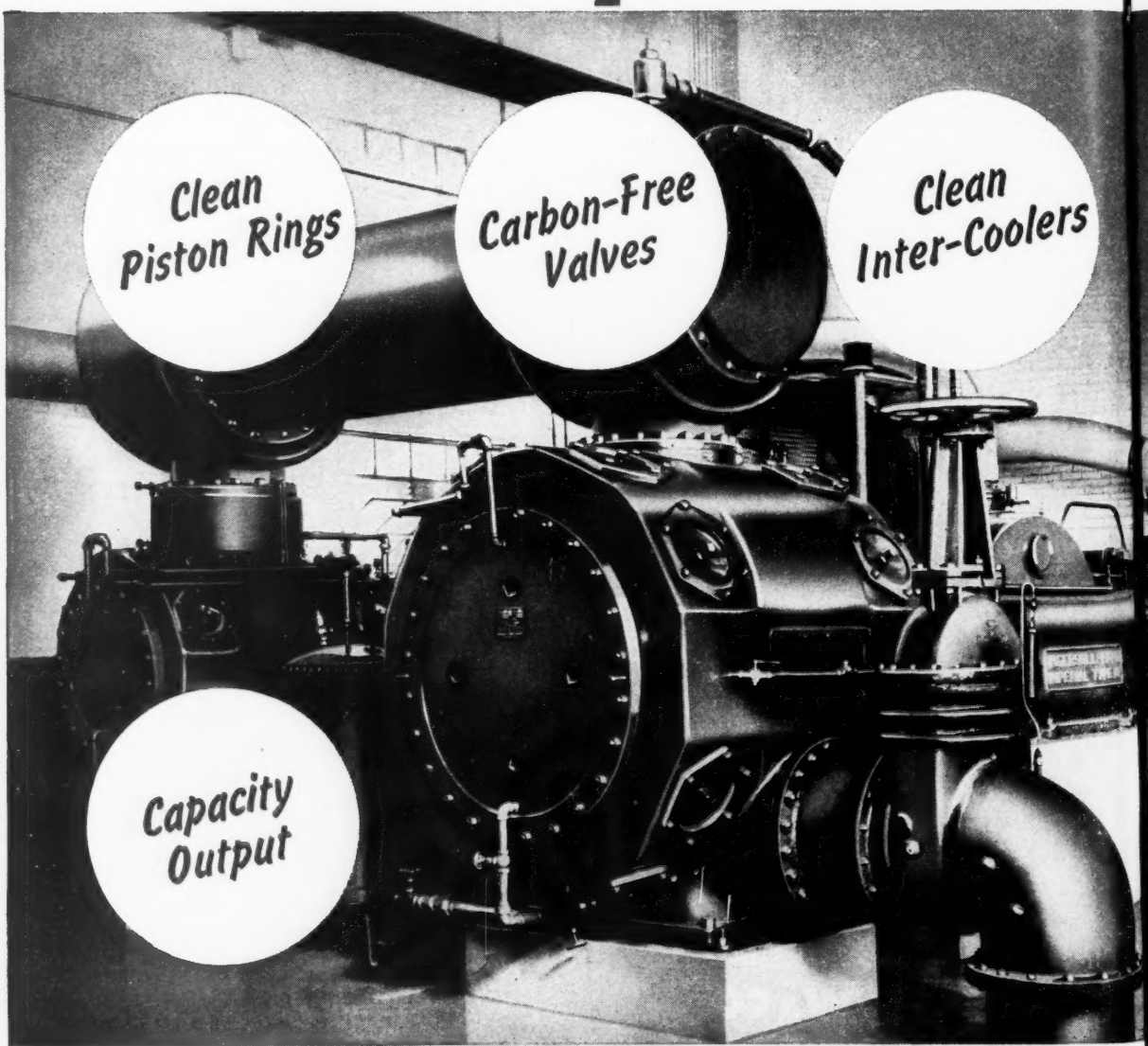
Drew Organics and Antifoams, used in conjunction with controlled chemical treatment and backed up by competent plant and consultation service, provide maximum boiler protection
Your local Drew engineer is available to discuss all aspects of water treatment and related problems.
POWER DREW CHEMICALS

TROUBLE-FREE

Under Any Pressure



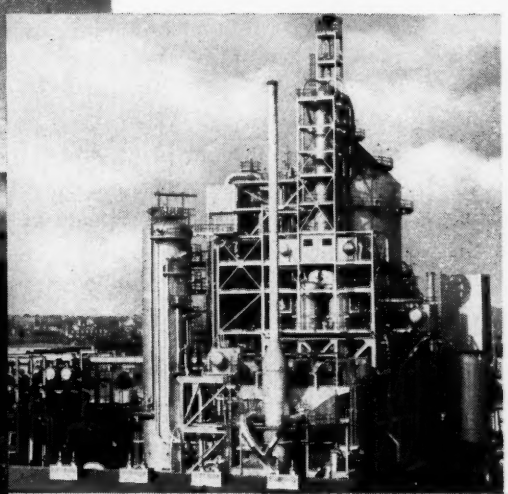
SINCLAIR

YOUR NEAREST SUPPLIER OF SINCLAIR PRODUCTS WILL GLADLY ARRANGE

Compressor Operation with Sinclair Rubilene

In many industries positive supply of air is a vital necessity . . . which means that reliable compressor performance is imperative.

With Sinclair RUBILENE, an operator can be confident of uninterrupted performance. RUBILENE has the ability to resist oxidation under high temperatures, to reduce carbon and sludging and to keep sustained lubricating quality through long service. It assures full capacity output by keeping valves and rings clean and free. For positive lubrication, better try RUBILENE.



New Fluid Catalytic Cracking Stills (like the one shown here) are helping to expand Sinclair's refinery output. Sinclair's great refineries are now turning out products at the rate of 150,000,000 gallons of lubricating oil yearly.

About 40% of all the Aircraft Engine Oil used by domestic Airlines in the U.S.A. is supplied by SINCLAIR. The same careful research that developed this high quality oil for the Airlines is put into RUBILENE and other Sinclair Oils.

INDUSTRIAL OILS

FOR LUBRICATION COUNSEL, OR YOU MAY WRITE TO SINCLAIR REFINING COMPANY, 630 FIFTH AVE., NEW YORK 20, N. Y.

...designed for industrial plants

adopted by public utilities

...the VU Unit

When the manufacturer of many of the world's largest central station boilers applies its experience to a unit for industry, it is not surprising that utilities, themselves, should adopt the design.

That's the year by year record of the VU Unit - verified again in 1947 by *utility* orders and installations with a total capacity of more than 6,500,000 lb of steam per hr. There could be no stronger endorsement than this, for steam is the prime product of a central station, where efficiency depends on economical steam generation – continuously.

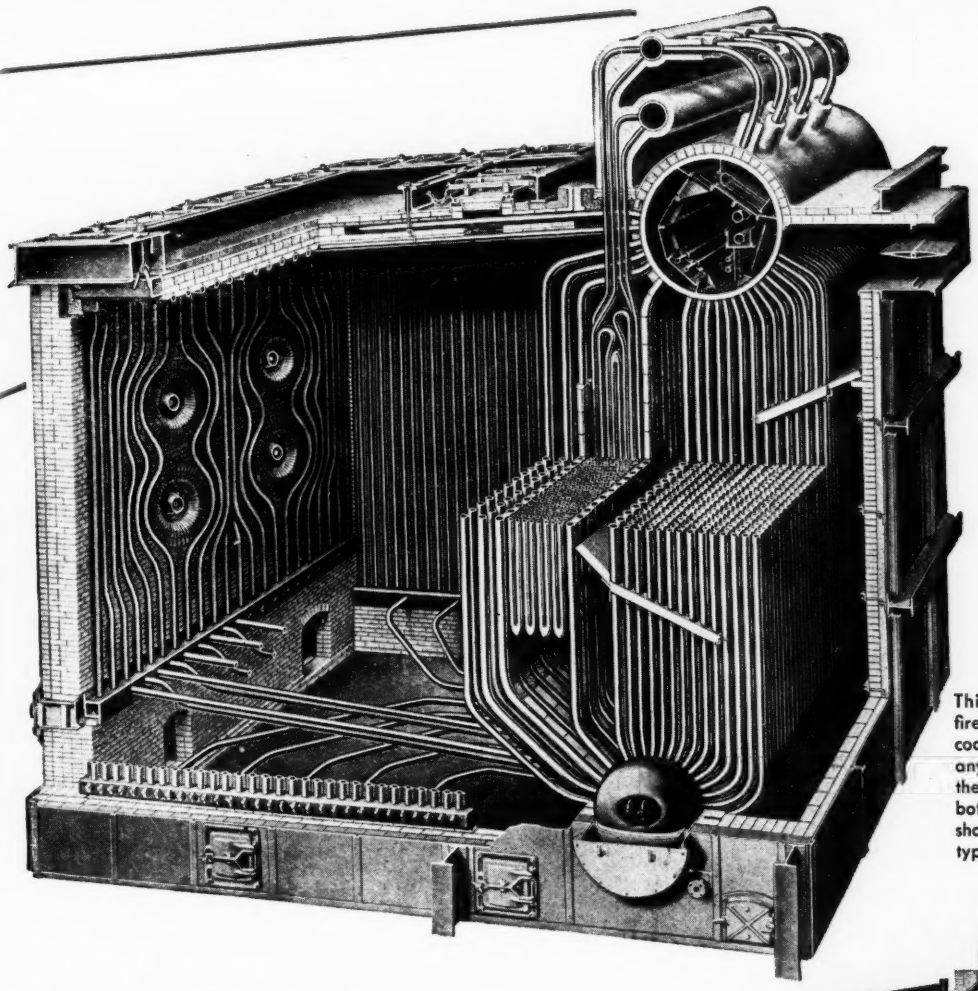
Think what central station performance could mean in your plant – high availability, low maintenance, quick response to extreme fluctuations in load, dry steam at all ratings and efficiency as high as 88 per cent. All this, and more, at a first cost which reflects the economies of standardized design.

And there is good reason for calling the VU the Versatile Unit, for it is available in capacity ranges from as low as 20,000 lb of steam per hr to 350,000 lb of steam per hr; design pressures may vary from approximately 160 to 1000 psi, with steam temperatures up to 900 F and beyond.

Moreover, your location with respect to

COMBUSTION ENGINEERING

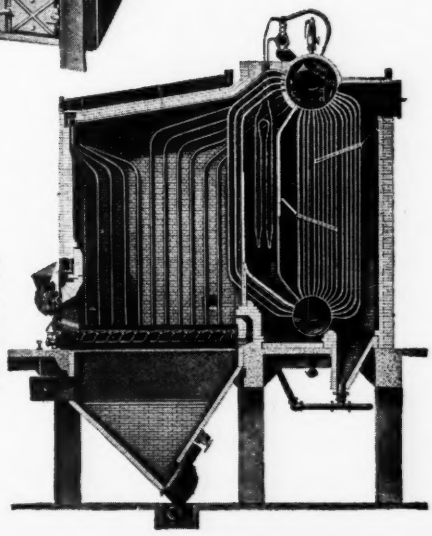
A MERGER OF COMBUSTION ENGINEERING COMPANY, INC. AND THE SUPERHEATER COMPANY



This unit may be fired by pulverized coal, oil, or gas, or any combination of these fuels. Furnace bottom may be as shown or of hopper type.

fuel sources is no bar to enjoying VU advantages, for virtually all fuels and methods of firing can be used. The VU is supplied for burning pulverized coal, oil, or gas – or any combination of these fuels. It may be had with every basic type of stoker – spreader, underfeed, or travelling grate. Bagasse, and other waste products, can also be utilized.

Yes, VU versatility has brought public utility performance to many diverse industries throughout the United States and abroad. It can bring it to your plant too – with marked economies in operation. B-214



VU equipped with a C-E Spreader Stoker. Furnace proportions and water walls may be adapted to firing by any type of mechanical stoker.

— SUPERHEATER, INC.

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C-E

DOUBLE PIONEERING
of Cooling Towers with Plastic Fans
FIRST—In 1941, C. H. Wheeler pioneered adjustable pitch plastic fans for medium size water cooling towers. They proved superior in installation after installation, under a wide variety of corrosive, abrasive and other destructive conditions. Users have only praise for them. And their welded steel hub with a 20-to-1 safety factor has never "thrown a blade."
SECOND—In 1948, this successful experience led to the pioneering of plastic fans for the largest towers. After you get the details, this plastic fan construction will be one more reason for specifying C. H. Wheeler Water Cooling Towers. All fans have a guaranteed air delivery, and the towers are guaranteed for water cooling performance, and their standard heavy duty construction is guaranteed to withstand hurricane winds up to 100 M.P.H. Each tower is individually engineered and custom built on the job to assure lasting satisfaction. Catalog on request.
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REPRESENTATIVES IN MOST PRINCIPAL CITIES
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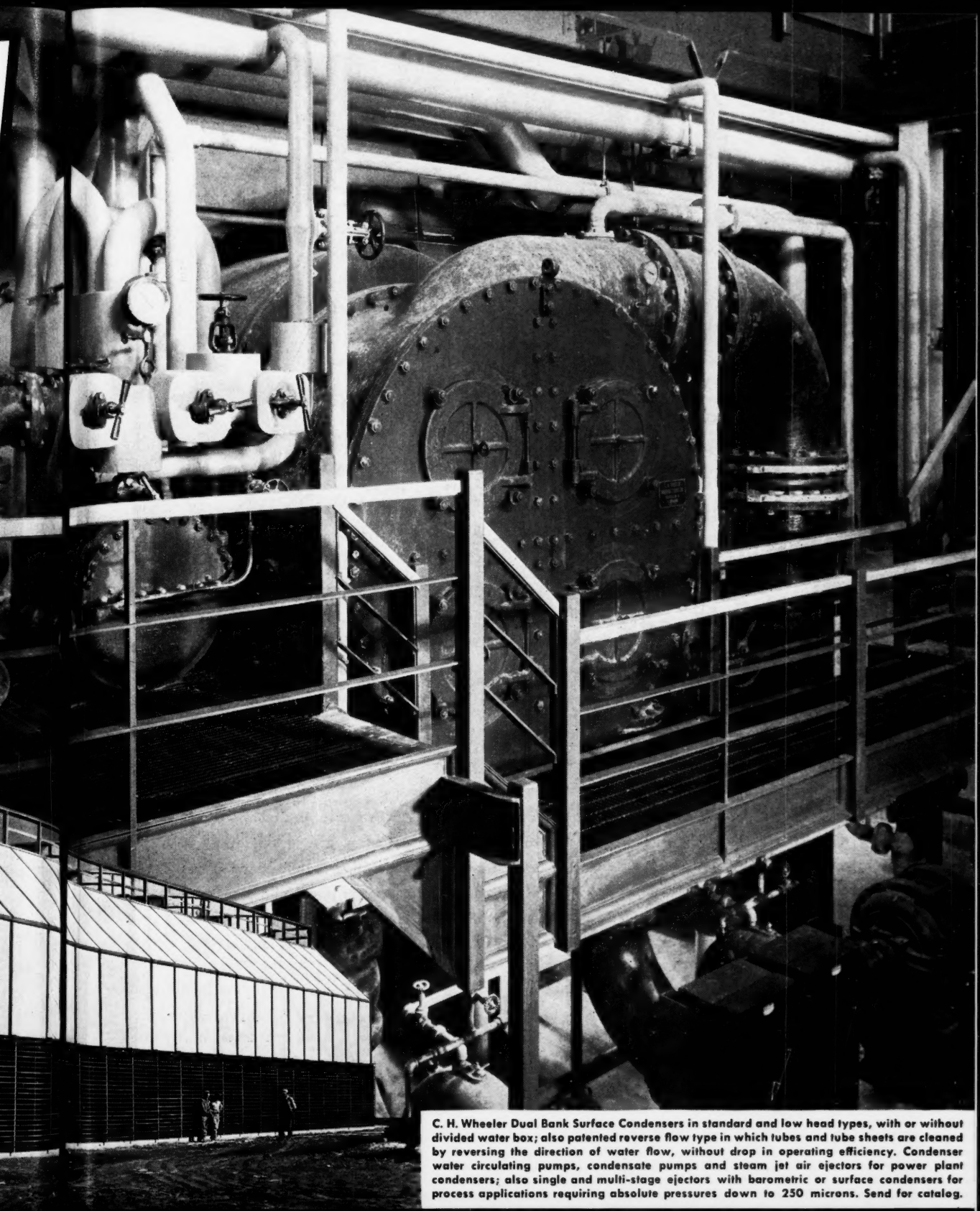


C. H. Wheeler Dual Bank Surface Condensers in standard and low head types, with or without divided water box; also patented reverse flow type in which tubes and tube sheets are cleaned by reversing the direction of water flow, without drop in operating efficiency. Condenser water circulating pumps, condensate pumps and steam jet air ejectors for power plant condensers; also single and multi-stage ejectors with barometric or surface condensers for process applications requiring absolute pressures down to 250 microns. Send for catalog.

STEAM CONDENSERS • WATER COOLING TOWERS
EJECTORS • STEAM JET VACUUM REFRIGERATION

OF PHILADELPHIA

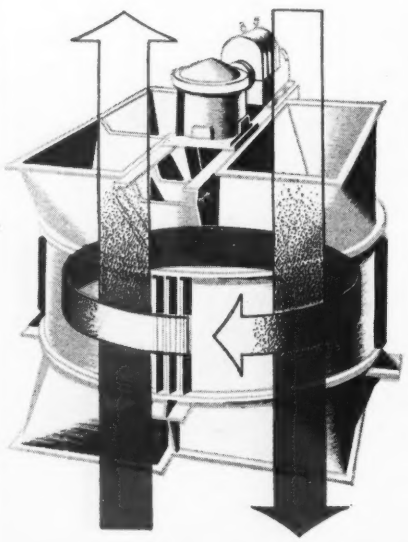
Fact File on Preheat

No. 3

The regenerative principle of heat exchange favors a high ratio of effective surface area to unit volume. In the Ljungstrom, this is accomplished by a compact arrangement of heat-transfer elements.

All the characteristics of the Ljungstrom's rotating heat-transfer unit—its surface area, size and shape of passages, and counter-flow arrangement—act to obtain maximum heat recovery for the unit's size and weight.

LJUNGSTROM



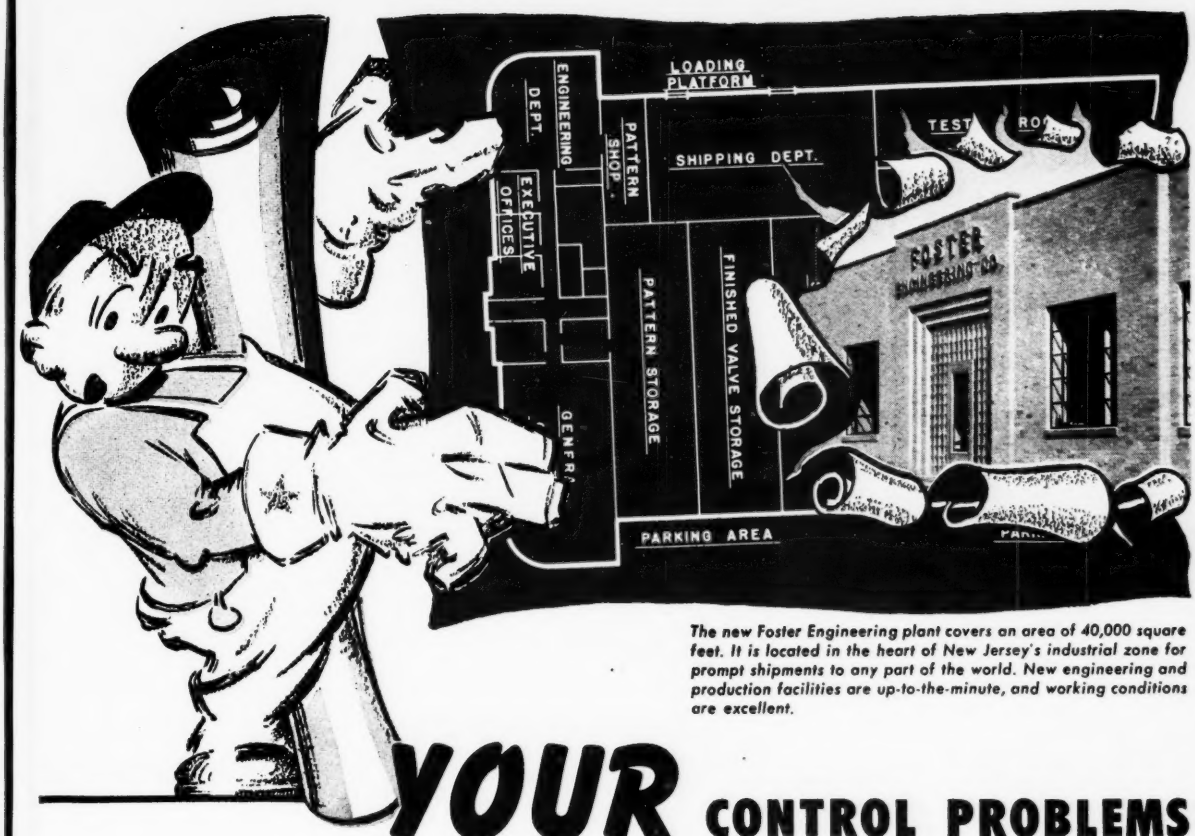
The Ljungstrom Air Preheater is a compact gas-to-air or gas-to-gas heat exchanger, operating on a continuous regenerative counterflow basis. Hundreds of leading power plants and other special applications confirm its high level of heat recovery and long-term low maintenance service.

THE

AIR PREHEATER CORPORATION

60 EAST 42ND STREET • NEW YORK 17, N. Y.

Plant: Wellsville, N. Y. 1284



The new Foster Engineering plant covers an area of 40,000 square feet. It is located in the heart of New Jersey's industrial zone for prompt shipments to any part of the world. New engineering and production facilities are up-to-the-minute, and working conditions are excellent.

YOUR CONTROL PROBLEMS went into these blueprints...

WE BUILD:

- Pressure Regulators
- Relief Valves
- Back Pressure Valves
- Altitude Valves
- Fan Engine Regulators
- Pump Governors
- Temperature Regulators
- Float Valves
- Lever Balanced Valves
- Non Return Valves
- Vacuum Breakers
- Vacuum Regulators
- Safety Valves

We are now in our new plant.

For months, while this plant was still in the blueprint stage, plans were carefully made and checked to provide facilities which would enable us to match your present and future service conditions.

For you, this means better answers to your control problems, because, with our new development and testing equipment, and with our new production set up, we can build a line of automatic valves which will give you better regulation than you have ever had before.

For us, it means renewed confidence in our ability to build valves which will give dependable regulation year in, year out, with a minimum of maintenance—valves that fit the job.

FOSTER ENGINEERING Company

OUR NEW ADDRESS

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Equipment by

for CONTROL SYSTEMS

Hagan pioneered in the field of automatic combustion control systems for both stationary and marine boilers—and still leads. Engineering of these and other control systems is one of Hagan's major activities, but the components of these systems are suitable for many other applications, and may be purchased separately.

for FLOW MEASUREMENT

The Hagan Ring Balance Flow Meter is a rugged and accurate instrument, adapted for a wide range of static and differential pressures. Calibration is the same for dry or wet service; range changing is exceptionally easy. Suitable for water, steam, air, gas, oil, and other fluids. *No stuffing boxes.* Calibration by dead weight method checks or takes the place of water column methods. Photos show a few typical models of this meter.

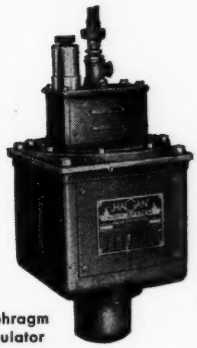
for FORCE MEASUREMENT and other purposes

As designers of control systems, Hagan engineers have on many occasions encountered problems which required the development of special equipment. Some of this equipment has proved to have a wider field than the original application, and has been made commercially available. Several such units are shown here.

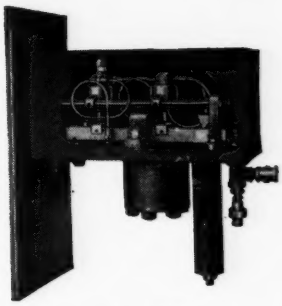
• • •

For full information on any of this equipment and its application to your specific problems, write to Hagan Corporation, Hagan Building, Pittsburgh 30, Pa.

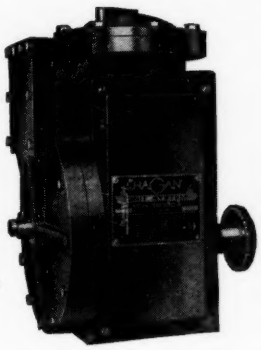
HAGAN



Diaphragm Regulator

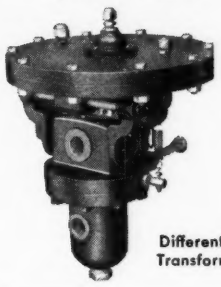


Type "F" Master Sender

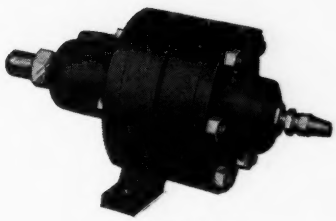


Variable Ratio Regulator

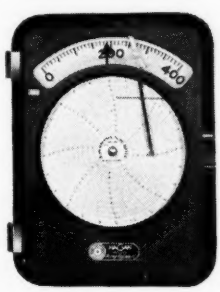
Receiving Regulator



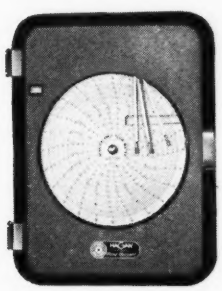
Differential Transformer



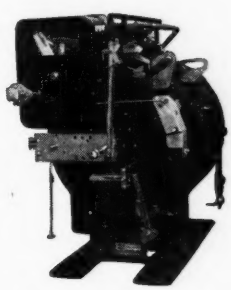
Type "F" Totalizer



Ring Balance Flow Meter (Indicating, Integrating & Recording)

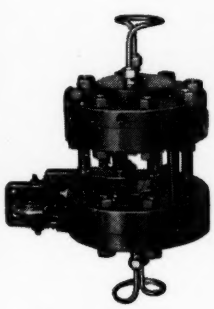


Ring Balance Flow Meter (Integrating & Recording)



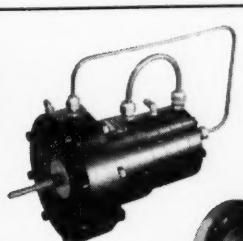
Dual Meter with Integrator (Case Removed)

Single Ring Meter without Integrator (Rear View)

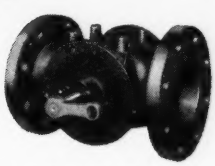


Hagan ThrusTorq

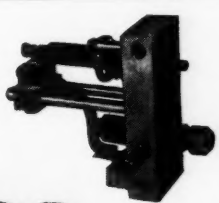
Steam Separator



MicroServo



V Port Butterfly Valve



MicroTrans

Thermostat

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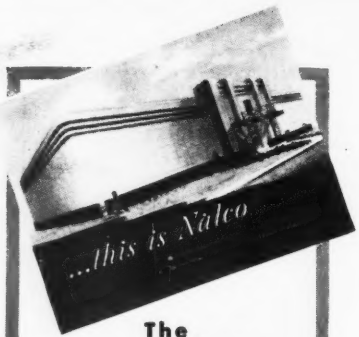
. . . How it Guarantees Water Treatment Results in Your Plant



The NALCO STORY

Second-best to a Nalco visit *in person* is the full-color tour presented in "This is Nalco." Here are the graphic proofs of Nalco water treatment responsibility. Your copy will be sent promptly upon request, without obligation. Write today.

WHEN your plant water treatment is under the Nalco System, Nalco Responsibility is positive assurance that no opportunities for water treatment economies will be overlooked . . . It represents *security* to thousands of plant operators—who know, from long experience, they can be certain that the best water treatment chemicals and methods are permanently on the job with the *best interests of* Nalco System *users* always foremost.

Nalco responsibility is the added bonus over *progressive* water treatment ability and unexcelled laboratory and production facilities. You can pare *your* responsibilities by putting the Nalco System to work in your plant . . . Call or write for data on how easily this may be accomplished.

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HELPFUL BULLETINS

Answers to many operating and maintenance problems will be found in these new bulletins and catalogs. List paragraph numbers of those you want on coupon below, detach and mail

ELECTRICAL

101 **Distribution Transformers** — All-purpose distribution transformers for indoor or outdoor installation are the subject of 4-pp Bulletin 49-ACO. It discusses construction features of the transformers, and illustrates, by photographs, several models. Also describes and illustrates several special transformers. Marcus Transformer Co., Inc.

102 **Electrical Tape Bulletin** — Some of the many applications for an electrical tape with plastic backing are illustrated by photograph in this 4-pp bulletin. It describes, briefly, the advantages of this tape in insulating, holding and protecting, and lists its physical and chemical properties. Minnesota Mining & Mfg. Co.

103 **A-C Generator Bulletin** — Alternating current, high-speed, coupled-type generators are featured in 8-pp Bulletin 05B6031B. Construction features of both the bracket and pedestal type bearing synchronous generators are described and illustrated by photos, with the explanation that they provide efficient, reliable power for construction work, permanent or temporary lighting and power jobs, plants in remote areas and as reserve power in factories and pumping stations. A table of ratings of standard bracket bearing generators is included, as are recommendation for applications of both types of bearing construction. Allis-Chalmers Mfg. Co.

104 **Synchronous Motors**—Operating advantages and construction features of bracket bearing synchronous motors in sizes from 30 to 1000 hp are described in Bulletin 05B6112A, 16 pp. It covers standard open type motors and those with special features for various service requirements, including units with enclosed collector assemblies, separately ventilated and totally enclosed motors. Explains rating and speed limitation of motors for belted service. Also touches upon vertical synchronous motors for pump drives, exciters and starters. Bulletin is generously illustrated with photos of motors and parts. Allis-Chalmers Mfg. Co.

105 **Motor Starter Bulletin**—A-c full voltage starters to meet requirements of any type of motor drive are covered in illustrated Bulletin 12B7132, 12 pp. Discusses across-the-line motor control, construction features and operating arrangements. Manual and magnetic across-the-line starters, combination and reversing starters and push-button control stations are described and illustrated. Photographs show open-type models and standard enclosures. Allis-Chalmers Mfg. Co.

106 **Synchronous Motor Construction**—All parts used in the construction of manufacturer's Fabri-Steel low-speed synchronous motor are illustrated by photograph and fully described in 4-pp Bulletin PB 5000-1. Also covers mechanical modifications. Elliott Co.

BOILER EQUIPMENT

107 **Dowtherm Vaporizer** — Bulletin No. 48-2, describing manufacturer's Type "A" Dowtherm Vaporizer, tells how this unit is designed to evaporate Dowtherm in such a way as to provide dependable operation at maximum temperatures, discussing its construction advantages in detail. It is illustrated with photos of the vaporizer and includes a dimensional drawing, vaporizer chart and specifications. Also included is table showing general properties of Dowtherm "A." The Wickes Boiler Co.

108 **Boiler Furnace Refractory Data** — Here are 32 pp devoted to refractories for boiler furnaces. They describe the product characteristics of both silicon carbide refractories and electric furnace mullites, and include graphs showing their thermal conductivity and thermal expansion. Bulletin also discusses and illustrates, by 2-color drawings, the use of these refractories in hand-fired boiler furnaces, oil and gas-fired packaged steam generators, fuel-fired furnaces, stoker-fired boiler furnaces, baffles and pits and header inlets. Tables and dimensional sketches facilitate ordering for a specific installation. Also included are a table of natural trigonometrical functions and one giving information on manufacturer's refractory cements and their applications. The Carborundum Co.

109 **Coal Scale Data Book**—The answers to a power engineer's questions on coal scales are provided in this excellent 48-pp book, Bulletin 1143, covering scales for recording weight of coal consumed by individual boilers and weight of coal receipts from ship, car, truck or storage. It is generously illustrated with photographs of models and accessories and actual plant installations and contains all necessary engineering drawings, dimensional data and detailed specifications. Construction features and operation of weighing and feeding systems are described. Richardson Scale Co.

COOLING, AIR CONDITIONING

110 **Air Conditioning Equipment** — Illustrated Bulletin No. 3923, 36 pp, utilizes every means of supplying the user with information necessary for selecting an air washer or dehumidifier to meet his plant's requirements. Book describes and illustrates design features, specifications and applications. Contains examples showing how selection of proper model is figured in typical problems of cooling and dehumidifying, final dry bulb temperature, evaporative cooling, humidifying with hot water, and water cooling. It includes tables showing total heat removal, air washer performance factors, total heat addition, enthalpy of air and specific volume of saturated air. Operational diagrams and physical data are provided for Classes 8, 6, and 4 air washers and 2 pp are devoted to weir and strainer modifications and special air washers. American Blower Corp.

111 **Unit Coolers**—Catalog 122, 10 pp, covers overhead blower units for produce cooling, designed and recommended for use with ammonia, methyl chloride and freon. It gives specifications and construction details for complete units and is illustrated with photos of blowers and dimensional diagrams. Also describes and illustrates coils, bends and fabricated piping available. Rempe Co.

TURBINES AND PUMPS

112 **Industrial Turbine Information**—B-3896, a 20-pp booklet, contains basic information on manufacturer's Type E industrial turbines for pump, fan, compressor and generator drives. Cut away views show operating features and general construction. Includes a detailed description and illustrations of governor assembly, overspeed valve and other parts. Accessories for special requirements, such as a hand speed changer, differential-pressure regulator, remote control for trip mechanism, are also illustrated. General and material specifications are listed and there's also a guide to aid in selecting proper turbine for steam condition and types of load. Westinghouse Electric Corp.

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113 **Engine Governor Bulletin**—A self-lubricated, fully enclosed governor is the subject of 4-pp Bulletin No. 502. It contains photos of the full assembly and manual and remote controls, and a detailed explanation of how this governor is designed to provide precise, dependable engine speed control. Also discusses the installation and maintenance of the governor and includes listing of available parts. Troy Engine & Machine Co.

113A **Centrifugal Pumps**—This 6-pp bulletin is filled with photographs of centrifugal pumps for all purposes from a portable pump driven by gasoline motor to a dual pump unit with 2-stage pump discharging through economizer and 2-stage pump delivering direct to boilers. Bulletin also describes, briefly, the general features of manufacturer's line of pumps. The Frederick Iron & Steel Co.

PIPING AND VALVES

114 **Bouncing Pipes**—This 16-pp bulletin, illustrated with interesting sketches, shows very simply and graphically what makes pipelines vibrate. In layman's language, it explains the fundamental concepts of the oscillating flow of gases through pipes and why it produces vibration. This vibration can be stopped, in many cases, by putting traps in the line to stop the oscillations. These traps, or snubbers, as manufactured by the company, are described in detail in a second 4-pp illustrated bulletin entitled, "Bring Your Plant Up to Date with Burgess-Manning Heavy-Duty Slug Buster Snubber." The latter gives dimensions and prices, which range from $95 to $1900, depending on type and size. Burgess-Manning Co.

115 **Pipe Tool Catalog** — Manufacturer's line of pipe tools is illustrated and described in this 16-pp catalog. It covers pipe wrenches, threaders, cutters, vises, extractors, reamers and portable power machines, also parts and accessories. It carries photos of tools, lists available sizes and capacities, explains their operation and includes ordering information and prices. The Ridge Tool Co.

116 **New Valves — Circular No. 582** describes and illustrates a new line of 125 lb sp bronze globe, angle and check valves. It includes cut-away illustrations, a discussion of construction features, and leading dimensions. The Lunkenheimer Co.

INSTRUMENTS AND CONTROLS

117 **Instrument Handbook**—"Modern pH and Chlorine Control" is a 100-pp catalog containing a great deal of valuable information in addition to covering manufacturer's line of scientific instruments and accessories. It explains the meaning of pH control, the electrometric and colorimetric methods of determining pH, and gives values of common acids, bases and foods, as well as maximum capacities of buffer systems. It also discusses in detail the applications of pH and chlorine control in air conditioning, water treatment, boiler water and many other industrial applications, recommending instruments and solutions. Instruments are illustrated by photograph, their functions described and sizes and prices given. W. A. Taylor & Co.

118 **Temperature Indicator and Recorder**—This 4-pp publication describes the Speedomax, a versatile instrument designed to save money in power plant operation. It explains how the Speedomax can be used to indicate and record as many as 160 separate temperatures. Discusses in detail its four different types of operation: continuous indicating, automatic starting of recording, continuous recording, and selective indicating or recording. It is illustrated with photos of the instruments. Also describes and illustrates a thermocouple assembly. Leeds & Northrup Co.

119 **Photoelectric Cell Data**—Catalog No. VC-4000 provides 12 pp of technical data on self-generating photoelectric cells. It covers their construction, service life, fatigue characteristics, electrical characteristics, output current, open circuit voltage, power output, internal resistance, frequency and spectral response, as well as their applications. It's illustrated with sectional sketches, photos, dimensional drawings, graphs showing output current, and electrical diagrams. Includes ordering information. Vickers Electrical Div., Vickers Inc.

120 **Condensate Drainage Control** — Manufacturer's system of high-pressure and high temperature condensate drainage control is fully explained in 24-pp Publication No. 3250. Contains useful data on steam flow conditions and heat exchange characteristics. Gives material and operating specifications and capacity ratings for both standard and high differential units in six sizes from 3 to 25 hp based on a maximum of 200 psi above process pressure. Differential pressures to 200 psi are listed and capacities for each unit tabulated for unit inlet pressures. Illustrations include many photographs and dimensional drawings in color showing design and construction of both types of drainage control units. Several pages are devoted to discussing good results obtained from use of these systems in various industries. Cochrane Corp.

121 **Steam Equipment Catalog** — Sixty-pp Catalog 49 covering manufacturer's steam and liquid control equipment, also contains helpful engineering data. It lists precision pressure regulators, temperature regulators, combination pressures and temperature regulators, many types of valves, self-cleaning strainers, steam traps and accessories. Listings include photos of models and cut-away drawings, layout diagrams, dimensions and prices. Also included are steam capacity tables and flange data. O. C. Keckley Co.

WATER CONDITIONING

122 **Corrosion Treatment** — Technical Paper No. 114, 4-pp, is used to introduce Corrogen—a catalyzed sodium sulfite developed for faster chemical removal of dissolved oxygen in "once through" or "closed" systems, where oxygen supply is not periodically replenished. Illustrated with photographs and performance charts, this paper discusses the sources of oxygen, the mechanism of oxygen corrosion and the control of oxygen, including chemical deaeration by sodium sulfite. It explains how the use of catalytic aids can speed up oxygen-sulfite reaction. Tells how Corrogen should be used and cites recommended applications. W. H. & L. D. Betz.

123 **Water Softener Equipment** — How the problems caused by hard water can be offset by the use of water softeners is explained in Bulletin 2386, 12 pp, describing ion exchange equipment. It covers in detail downflow, upflow and gravity zeolite water softeners. Contains a 2-pp cutaway illustration of a fully automatic softener to show how an ion exchanger is built and how it works. Bulletin also contains flow diagrams showing arrangements for installation of water softeners and includes detailed, illustrated discussion of multiport valves used in them. The Permutit Co.

HOSE

124 **Air Hose Booklet** — Manufacturer's line's of air hose for welding, pneumatic tools and general air drill service are covered in Form NY-9667-A, 8 pp. It provides complete data on applications, construction and specifications for air hose as well as instructions for good air hose engineering practice, including tips on safety and correct coupling. Necessary tolerances for mandrel-made and lead-press cured hose are given. New York Belting & Packing Co.

125 **Flexible Hose Data**—Three recently issued catalog sections deal specifically with flexible hose for steam, air, and water lines. Section 3460, 4 pp, describes and illustrates a highly-flexible lightweight air hose, useful wherever a 3/16 to ½ in. size is needed, and also serviceable in welding, on petroleum and lubricating oil lines or as low pressure hydraulic hose. Section 4600, 4 pp, features a hose designed for water suction up to full vacuum or discharge service up to 30 psi. Section 4500 (and 4510) covering steam hose, describes manufacturer's "Burstproof" hose recommended as safe in any application and two other brands for less rigorous service. The B. F. Goodrich Co.

(Continued on page 112)

JUNE, 1949

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SPECIALISTS IN SCALE AND SLUDGE REMOVAL WITH CHEMICALS

Condenser efficiency restored-

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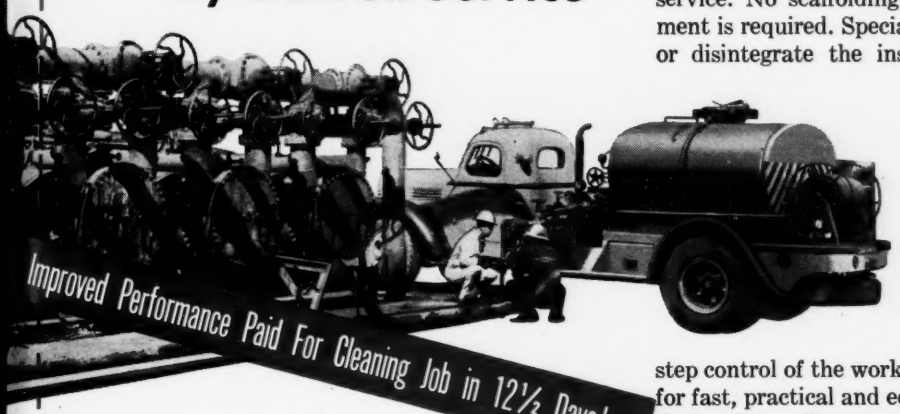

The water sides of fifteen tube and shell condensers in a West Texas refinery were almost plugged by heavy scale deposits. Dowell was called in to clean them. After a six hour soaking with specially selected Dowell solvents, they were flushed out and returned to service. Following this chemical cleaning, gasoline left the condensers 20°F cooler than after a previous mechanical cleaning. *The improvement in operating economy paid for the job in 12½ days!*

When you specify Dowell Chemical Scale Removal Service for your cleaning job, you get fast, convenient service. No scaffolding or dismantling of the equipment is required. Special solvents designed to dissolve or disintegrate the insulating scale are pumped in and out through existing connections. Costly down time is minimized.

Experienced Dowell engineers do the job. They bring the essential equipment — truck-mounted tanks, pumps, heaters, and chemical proportioners— to make possible step by step control of the work. Call the nearest Dowell office for fast, practical and economical removal of scale and sludge from all types of heat exchange equipment, steam generators, water lines and water wells. Free cost estimates gladly given.

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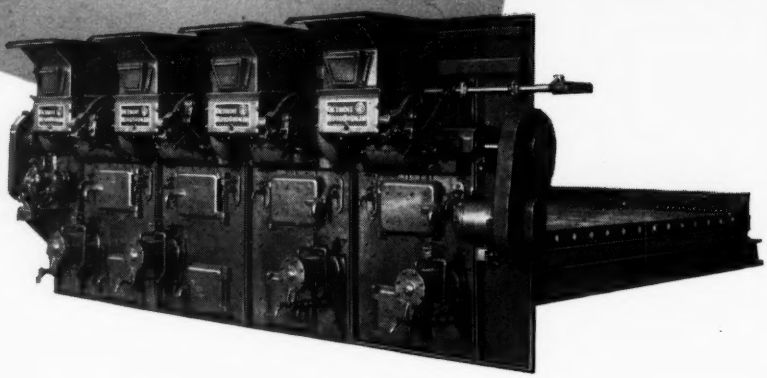
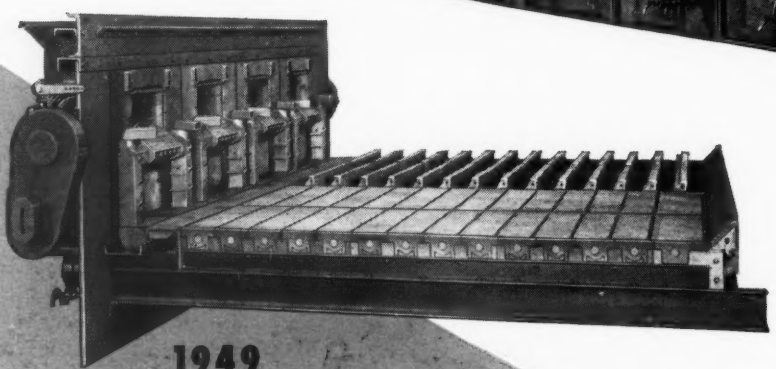
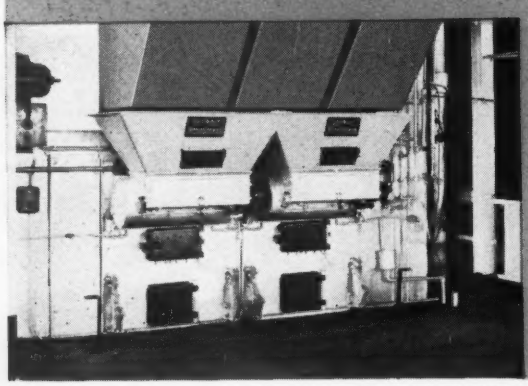
Over 1700 Coal Saving—Cost Cutting Installations of Detroit RotoStokers Since 1931





1949

Power Dumping RotoStoker with four Rotors, driven by one 2 hp motor, with auxiliary turbine. A portion of the grate is shown in the dumped position. Built for Bibb Manufacturing Co., textile mill, Columbus, Georgia. Capacity, 60,000 pounds of steam per hour.

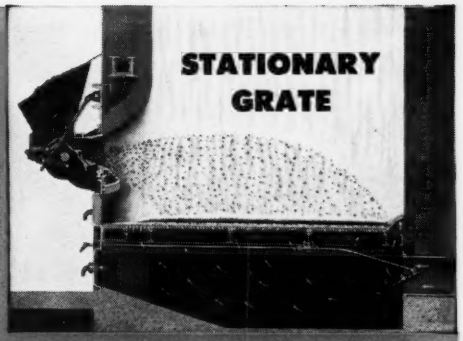


First RotoStoker Installed in 1931

This Hand Dumping RotoStoker in the Municipal Power Plant of Fort Morgan, Colorado, has been in service for 18 years—burning 9,000 B.T.U. Northern Colorado Lignite.

Our 51 Years in Stoker Manufacture Exclusively, Including 20 Years of SPREADER Stoker Experience IS AT YOUR SERVICE

A pioneer in spreader stoker design and building, we have made applications of Roto-Stokers to all types and makes of boilers in a wide variety of plants both here and abroad.



STATIONARY GRATE—*The Stationary Grate RotoStoker is readily applied to small and medium boilers where no basement for ash handling is provided.*

A DOUBLE SAVING

The RotoStoker provides a double saving:
Saves first—by increased efficiency.
Saves again—because it will burn any kind of Bituminous Coal or Lignite. Users, therefore, buy their coal at *best price advantage.*

RotoStoker burning rates are higher and will provide you with more capacity. The ability to handle fluctuating loads has made it popular.

The Detroit RotoStoker has distinct advantages over other methods of firing.

As stoker designers and builders of fuel burning equipment exclusively, we recommend in each case the method of firing best suited to your plant and the fuel available.

HAND DUMPING GRATE TYPE—*With the Hand Dumping RotoStoker, a shallow ash pit, as shown, is often sufficient. Ashes are discharged by releasing dumping levers and removed through the ash doors at the front when convenient.*

POWER DUMPING GRATE
—Steam Cylinders provide power for dumping. Each grate section is dumped independently of the others. Balance of the stoker carries the load with uniform steam pressure.

OTHER TYPES AND SIZES OF DETROIT STOKERS FOR EVERY INDUSTRIAL NEED

DETROIT SINCE 1898 STOKERS

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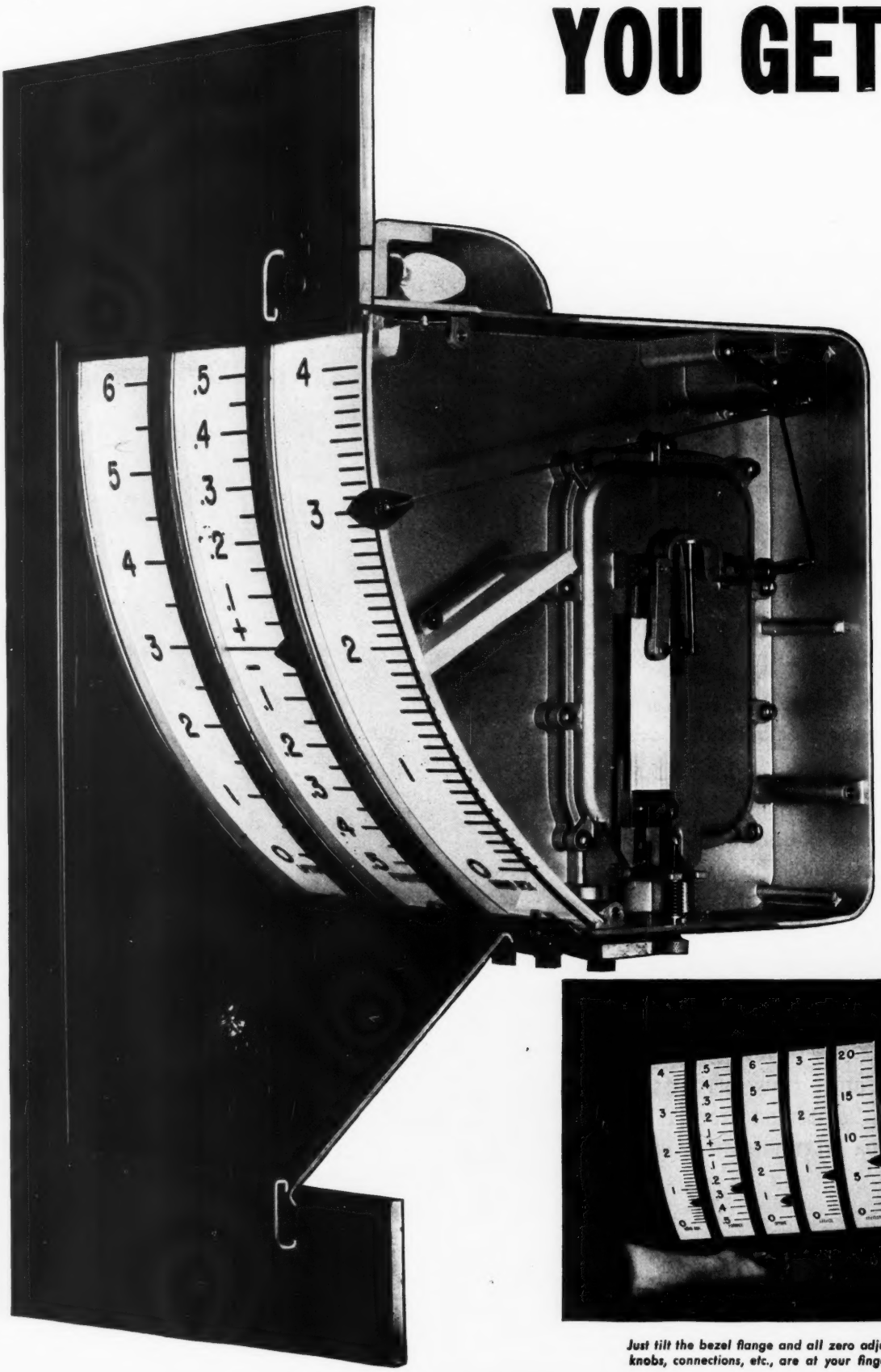
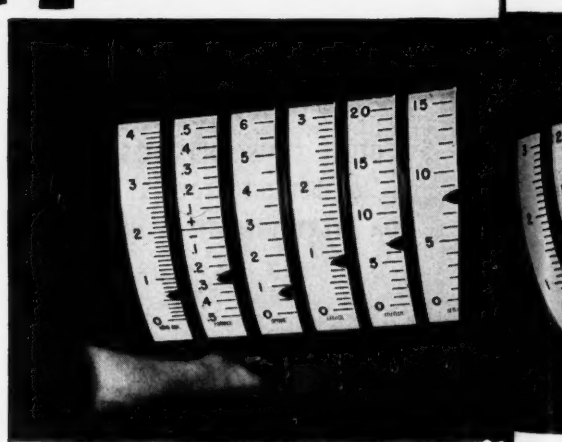




Just tilt the bezel flange and all zero adjustment knobs, connections, etc., are at your finger tips.

ALL OF THESE FEATURES

In The Republic Multi-Point Draft and Pressure Gage

1. EASY TO OPERATE: All adjustments can be made from the front of the gage regardless of whether it be flush or projected mounted. On the flush mounted gage a bezel flange, which tilts back, conceals the zero adjusting knobs, pipe connections, mounting bolts, etc.

2. INDIVIDUAL UNITS: Each draft or pressure element is individually housed in a die cast case forming a complete compact unit.

3. UNITS EASILY REMOVED: The individual units can be removed from the front of the gage as you would remove a book from a shelf. This can be easily and quickly done without interfering with the operation of any other unit.

4. EASY TO MAINTAIN: Because each element is a complete unit in itself which can be easily removed, maintenance is greatly simplified.

5. INDIVIDUAL ILLUMINATION: Each scale is individually illuminated from the back by a light located outside of the element housing.

6. UNIFORM SIZE: All units are of one standard size which permits new units to be added or interchanged as required.

7. ALL STANDARD RANGES: Elements are supplied for all standard ranges of draft, pressure or differential.

8. SENSITIVE DIAPHRAGM: All elements, except those for high pressures, are actuated by an extremely sensitive bellows type of diaphragm.

9. MULTIPLE UNITS: Any number of units of draft, pressure or differential may be combined in one multi-point gage which is supplied for either flush or projected mounting.

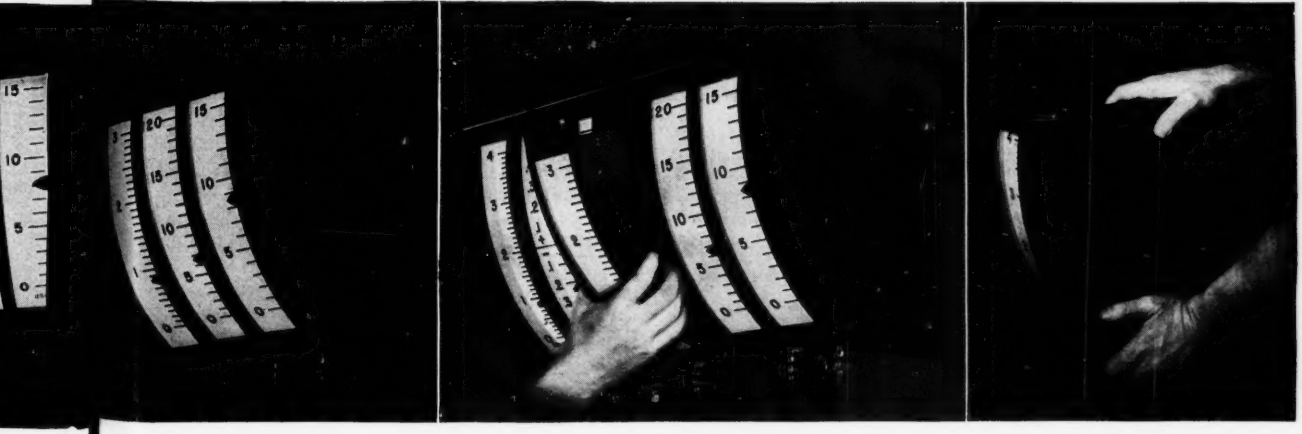
10. FLOW, CO_2, TEMPERATURE: Developed primarily to indicate drafts, pressures and differentials, the Republic multi-point gage can also be made to indicate other quantities such as flow, CO_2, temperature, liquid level, etc. In each case the corresponding standard Republic instrument is used.

The sectional view shown on the opposite page illustrates the extreme simplicity and compactness of the Republic Multi-Point Draft and Pressure Gage. Every detail has been designed to assure ease of maintenance and continuous operation as well as accuracy and sensitivity.

Write for a copy of Bulletin No. 802

REPUBLIC FLOW METERS CO.

2240 DIVERSEY PKWY. **CHICAGO 47, ILLINOIS**



Supplied for either flush or projected mounting.

Any unit can be easily removed from the front without disturbing any other unit.

Each element is a complete, compact, sealed unit.

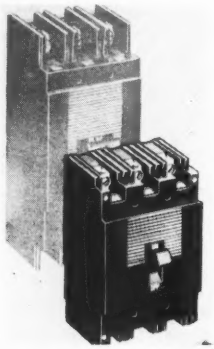
NEW EQUIPMENT NEWS

Use the coupon below when you want further information on the equipment described on this page and following pages. Write the identifying number or numbers in the space provided, clip the coupon and send it to Power Generation, 53 West Jackson Boulevard, Chicago 4, Illinois

1—CIRCUIT BREAKER

Is also available as circuit interrupter of high capacity

A new, compact 50-amp—600 v and 100-amp—250 v circuit breaker, the ML-1, includes all construction features of manufacturer's other breakers, but is 50 per cent smaller than previous unit for this capacity. It has a thermal-



magnetic (coilless) tripping mechanism, in which a thermal element holds harmless momentary overloads, but trips before wire insulation overheats on continuous overloads. A magnetic element trips quickly on shorts to localize damage. The company points out that repeat circuit protection is provided with maximum simplicity and down-time is minimized, for nothing burns out and there is nothing to replace.

The ML-1 breaker is available in special enclosures to meet every service application, including dust-resisting, rain-tight, weatherproof and dust-tight, and explosion-resisting styles. Ampere range is 15 to 50 amp at 600 v a-c, or 250 v d-c; or 70 to 100 amp at 250 v a-c or 125/250 v d-c. Square place.

2—STROBOSCOPE

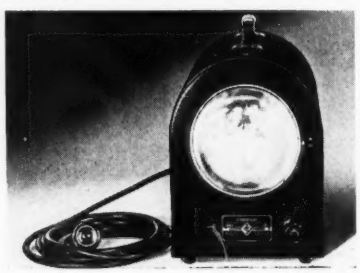
For observations on machinery running at relatively low speeds

The Strobolume is a high-intensity, short-flash stroboscope for observations on fuel injection systems and heavy machinery. With it, even a single, isolated flash is said to produce a definite stationary image of the moving object on the retina of the eye.

It is designed to be flashed from an external contactor, and is useful where motion to be examined is related to angular position of a shaft, such as a crankshaft, camshaft, or countershaft, on one end of which is held or clamped. A push-button is provided for tripping single flashes. The lamp can also be flashed from a special, slow-speed Strobolac. The Strobolume can also be used as light source in high speed photography.

It will operate continuously at speeds up to about 45 flashes per min. Operation for increasingly shorter periods is possible up to 1200 per min. Whenever maximum safe operating time is reached a circuit breaker opens to turn off power supply.

Compact and portable, instrument is housed in metal case with handle. Over-all dimensions are 13 by 7½ in., net weight is 18½ lb. Lamp assembly is connected to power supply through a 10-ft cable and is removable. General Radio Co.



3—ELECTRIC PLIERS

Use current-resistance principle for faster, more positive soldering

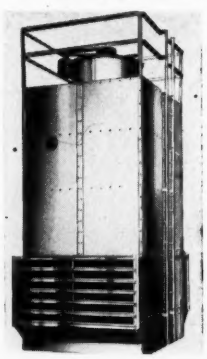
These Electric Soldering Pliers are said to provide freedom from "cold joints" and reduce soldering labor. According to manufacturer, their heat is instantaneous. Wires or parts to be soldered are held by pliers, the foot switch is depressed for an instant, heating wires or parts enough to melt the solder. The current resistance principle is used to heat work only at point of contact.

Pliers remain cool at all times, it is claimed, and resultant joint requires less solder. This "heat in the work" process is designed to make a solder-weld at a localized point without heating entire terminal or scorching, burning or shrinking the insulation. Pliers are said to consume little current. They will handle from 14 to 30 gage copper wire. They can also be used to silver braze small metal parts. Durst Mfg. Co.

4—COOLING TOWER

Of medium to large capacity, is available in wood or steel construction

The Verflow is said to be easily erected, require little maintenance time and contain features usually found only in heavy-duty industrial towers. Among features claimed for it are "lifetime" nailless filling, easily removed and reinstalled; balanced spray system with low-pressure nozzles; access port; totally-enclosed motor; enclosed bearing housing with grease-packed bearings;



air-foil section cast aluminum alloy fans, multiple-celled units if desired; hinged louver frames and removable

JUNE, 1949

POWER GENERATION
53 W. Jackson Blvd.
Chicago 4, Illinois

Please have the manufacturers send me without obligation the literature indicated by the number:

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Your Name.....

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Your Company Name.....

Company Address.....

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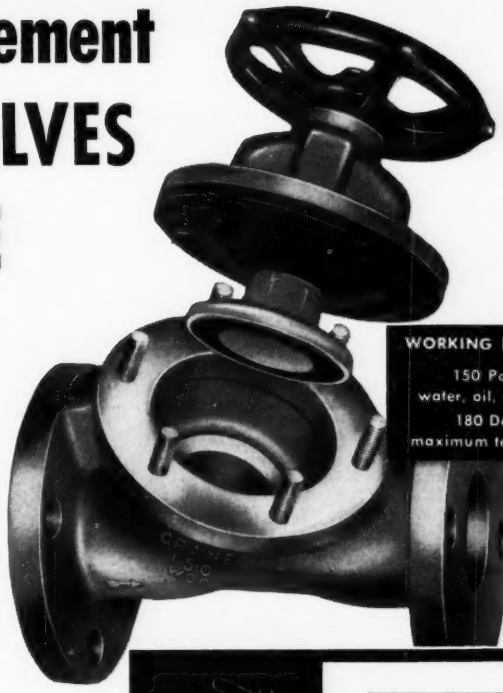
outstanding improvement in DIAPHRAGM VALVES by CRANE



WORKING PRESSURE:
150 Pounds
water, oil, air or gas
180 Deg. F.
maximum temperature

NEW SEATING ARRANGEMENT MORE DURABLE... SAFER... MORE EFFICIENT

Now, after completing exhaustive tests, Crane presents this better diaphragm valve—better suited for more services under today's working conditions. Stemming from basic improvements, such as the radically new bonnet-sealing and valve-seating arrangement, this original Crane design introduces many outstanding service features like those shown here.

1. LONGER DIAPHRAGM LIFE, because diaphragm is used *only* to seal the bonnet—not for seating purposes.

2. POSITIVE SHUT-OFF in case of diaphragm failure. This is an exclusive Crane safety feature.

3. ACCURATE SEATING—new flat face disc with durable, resilient seating surface assures tight closure on all fluids.

4. GREATER FLOW CAPACITY with reduced resistance and pressure drop, assured by Crane Y-pattern body design.

5. EASIER OPERATION—Crane separate disc and diaphragm construction takes less torque—fewer turns—to operate.

HOW IT WORKS

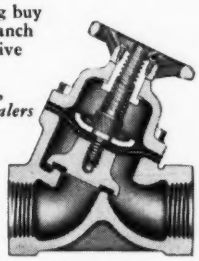
The Crane diaphragm serves one function only—sealing the bonnet. It is not subject to crushing and rapid wear. The seating member is a separate circular flat face disc, firmly attached to the stem and joined to the diaphragm with a special leakproof connection. This independent seating feature permits positive shut-off with no loss of fluid, even in case of diaphragm failure.

GET THIS DESCRIPTIVE CATALOG

See these new valves—the outstanding buy in their class—at your local Crane Branch or Wholesaler. Or write for descriptive catalog AD-1761.

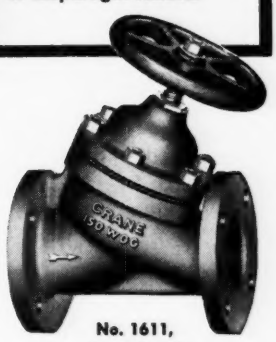
CRANE CO., 836 S. Michigan Ave., Chicago 5, Ill. *Branches and Wholesalers Serving All Industrial Areas.*

This new Crane line includes iron valves with screwed ends in sizes ½ to 2 in.; with flanged ends from ½ to 4 in. Neoprene coated valves—flanged ends only—in sizes from ½ to 4 in.



No. 1610, screwed ends

No. 1615, flanged ends, neoprene coated



No. 1611, flanged ends

EVERYTHING FROM . . .

VALVES
FITTINGS
PIPE

CRANE

PLUMBING AND HEATING

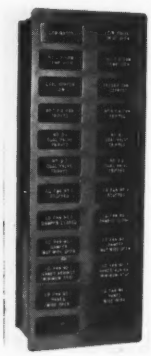
FOR EVERY PIPING SYSTEM

louvers. Wood towers have heavy double-sheathed casing; metal towers finished in corrosion-resistant paint. The Marley Co., Inc.

5—ANNUNCIATOR

For heavy duty operation in industrial plants, public utilties

The "ANFA" may be incorporated in new or existing control panels, actuator boards, or instrument panels to indicate occurrence, continuous or termination of any event that is physically perceptible. For example, it may be connected to the normally open contacts of a remote thermostat or thermocouple to indicate when a pre-determined high or low temperature is reached. It may also be utilized to indicate opening or closing of doors, valves or gates; to signal interruption of a beam of light between a lamp and the cell, or actuation of the cell in the presence of light; to indicate when a liquid level rises above or drops below a predetermined point; to signal starting, stopping or continuance of the flow of liquid.



Engraved designations on the 2 by 4½ in. Lamacoid windows, when illuminated, are said to be legible 30 ft.

The "ANFA" may be furnished to operate as means of communication between two remote points, as in a power generation station, where information must be relayed from one control point to another when a generator is to replace or augment another on the line. In this instance annunciator can be actuated by pushbuttons. The Autocall Co.

6—VERTICAL SPEED REDUCER

Is light weight, requires little headroom and uses stock parts

This vertical speed reducer is said to weigh only ½ to ⅓ as much as comparable units. Because little headroom is needed, it is adaptable to many industrial operations. It will provide any driven speed below 154 rpm from standard stock parts and is said to offer a vertical speed reduction drive at very low cost.

Designed for easy installation, the unit is built for mounting on the shaft of the driven machine. The drive can be selected and installed from simple catalog information, according to manufacturer. Other advantages claimed for it are quick speed changes (pulleys or sheaves of different diameters can be substituted in primary belt drive or standard adjustable-diameter sheaves used); easy change of location (interchangeable bushings permit application to shafts of various sizes), and quiet operation. The American Pulley Co.

7—PAINT SPRAY UNIT

For spraying any coating, is small and weighs only 74 lb

The portable paint spray unit is adaptable to maintenance work where speed and quality are required, but where the use of a large spray installation is not justified or practical. Manufacturer says that performance tests have shown this economical sprayer capable of spraying any coating with same efficiency as a 1-hp unit.

It is made to handle enamels, lacquers,

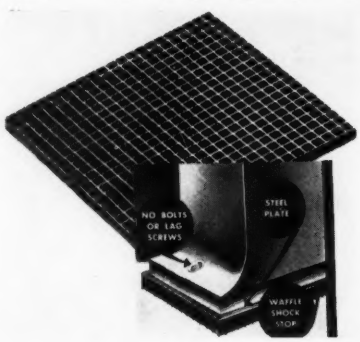
house and barn paint, shellacs, varnishes and other coatings. The (direct-drive piston) unit delivers 40 lb working pressure in ample volume to operate manufacturer's standard spray guns. It plugs into any 110-120 v a-c line. The compressor is only 15⅞ in. long, 11½ in. high and 7½ in. wide at the base. Motor has a safety cutout overload switch, and oversize cooling fins on compressor are designed for continuously cool operation. Binks Mfg. Co.

8—VIBRATION DAMPENERS

Are made of rubber and have a semi-pneumatic action

Vibrations set up by most types of motorized equipment can be isolated by placing Shock Stops between base or feet of the equipment and the floor or foundation. Floors, walls and ceiling are guarded from damage, noise is reduced and production increased, it is claimed. Shock Stops are said to be equally effective in protecting balances, electronic devices and similar delicate equipment from outside vibrations.

Available in large 18 by 18 in. sheets that may be cut to required sizes, and in circles of 3¼ and 2¼ in. dia. The waffle-like grid of the Shock Stop design when laid on a smooth surface tends to trap air, it is said. Vibrations of unwanted amplitudes are diverted by this air through supporting ribs. Manufacturer says tests show that where the disturbing frequency runs



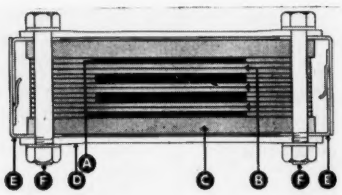
between 1000 and 3000 cycles per minute a reduction of 75 to 90 per cent may be obtained by the use of Shock Stops. The Connecticut Hard Rubber Co.

9—FEED-IN DUCT

In one-split bus arrangement for reducing voltage drop

This illustrated cross section is typical of a three-phase feed-in duct assembly, intended to greatly reduce voltage drop in the distribution of power over long distances. "One-split bus" (A), with halves positioned on either side of the other two busses separated by insulator plates, is designed to permit close spacing and electrical symmetry.

Solid ebonized asbestos insulating plates (B) and (C), enclosing busses, having both mechanical and high dielectric strength, are described as impervious to moisture and resistant to arcing. Surge clamps (D) and bolts (F) every 24 in., give structural and me-



chanical strength necessary to withstand 50,000 amp "shorts." Steel channels (E) complete housing.

Applications include service entrances from transformer banks to distribution centers, vertical distribution in multiple story buildings, low-drop transmission of large power blocks to utilization area and supplying of resistance welder and other loads having normally low power factor and high demand with a minimum voltage variation. Feed-in duct is available in 1200, 1600, 2000, 3000, and 4000-amp ratings, 2 and 3-wire single phase, 3-phase and 4-wire service for 600 v or less. Carries Underwriters' Laboratories approval. Square D Co.

10—TEMPERATURE INDICATORS

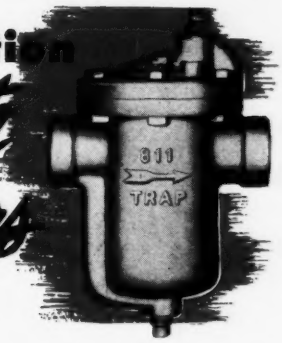
Are developed for use with operating temperatures up to 2000 F

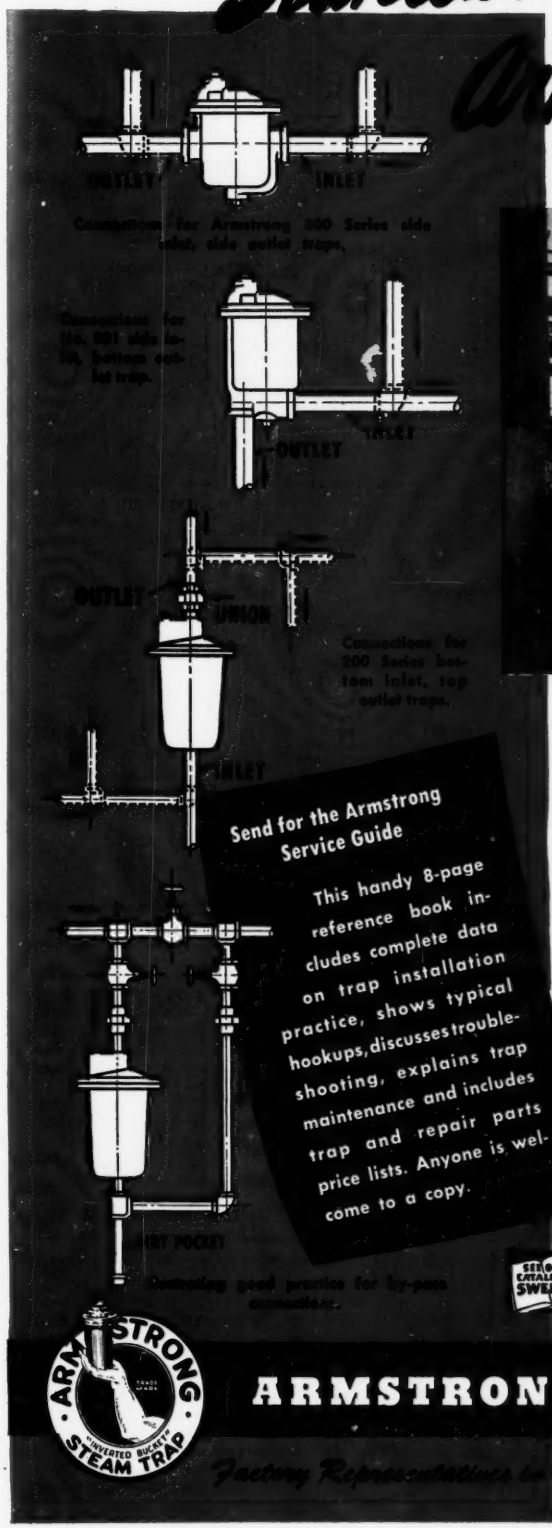
Both Tempilstiks (crayons) and Tempil Pellets can now, for the first time, be obtained in the temperature range be-

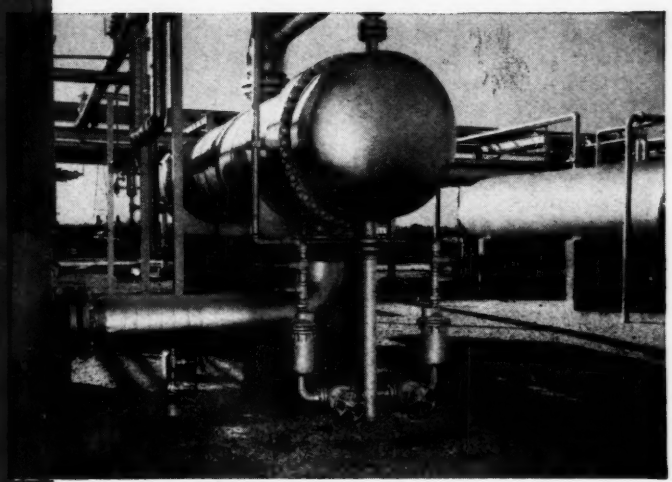
tween 1600 F and 2000 F. This is of special interest because of the growing importance of higher operating temperatures.

Beginning with 113 F, Tempilstiks and Tempil Pellets are now available in 12½-deg steps to 400 F and in 50-deg steps from 400 to 2000 F. Tempilaq, the paint form of temperature indicator, is available in similar intervals from 113 F to 1600 F only. Tempil Corp.

To Reduce Steam Trap Installation Costs *Standardize with Armstrongs*







Send for the Armstrong Service Guide

This handy 8-page reference book includes complete data on trap installation practice, shows typical hookups, discusses trouble-shooting, explains trap maintenance and includes trap and repair parts price lists. Anyone is welcome to a copy.

SEE OUR CATALOG IN SWEET'S

Small Size, Choice of Body Styles Save Time, Labor and Fittings

ARMSTRONG traps are compact, light and small in relation to capacity because the free-floating lever system permits full opening of a larger discharge orifice than is possible in other traps of comparable size. This makes them ideal for all installations, including those where space is limited. Even the largest size Armstrong traps rarely require any support other than the piping to which they are connected.

The choice of side inlet or bottom inlet body styles in sizes for the majority of installations permits the simplest possible hookups with a minimum of fittings.

For complete information on Armstrong Inverted Bucket Steam Traps for all services and all pressures call your nearest Armstrong representative or write direct to the factory.

ARMSTRONG MACHINE WORKS

810 Maple St., Three Rivers, Mich.

ARMSTRONG *Inverted Bucket* STEAM TRAPS

Factory Representatives in 48 Key Cities... Traps Stocked at 147 Points

11—SEQUENCE CONTROL

Is intended for the measurement and control of process variables

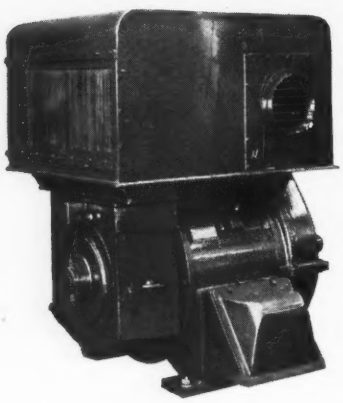
The Multi-Switch Capacitrol has been added to manufacturer's line of controllers. Incorporating a "distant view scale," front accessibility, plug-in in chassis design and voltage selector plug, the instrument is available with a maximum of four switches (single-pull, double throw) to provide a selection of six different switching sequences.

A high resistance, fully compensated, direct reading meter movement with Alnico V magnet is used for applications which fall in the pyrometric range. Models using resistance thermometer measuring systems are available for low temperature operation. Wheelco Instruments Co.

12—UNIT COOLED D-C MOTORS

Have new cooling assembly for long operation at low speeds

These motors, in ratings up to 200 hp have two blowers, driven by a single Tri-Clad induction motor, in the air-to-air cooling assembly to provide ventilation independent of motor speed. One blower circulates internal air through motor and cooler, while the other blows external air through the



cooler. The new cooling system is intended to make full torque possible down to almost zero speed continuously.

Motor air doesn't come in contact with outside air, it is said. For use in dusty, dirty and oil-laden atmospheres, G-E totally-enclosed, unit-cooled motors require no piping, ductwork, air filter or pressurized air supply. Large Motor and Generator Divs., General Electric Co.

13—PAVING BREAKER

Is lightweight, sturdy, and built for long service

Intended for fast demolition work and for use wherever footing is treacherous, this new paving breaker weighing only 38 lb, has been added to the manufacturer's heavier machines. Known as the B37, it has a renewable check liner, easily replaced at low cost. The hammer is of the block type pistol type, reversible for longer life. The use of a tappet is designed to minimize wear on the hammer striking face, and the tappet operates in a renewable bushing.

Said to be an exclusive feature of the B37 is the throttle valve lock, which works like the "safety" on a gun, thus enabling workmen to avoid accidents. The B37, too, is also said to minimize operator fatigue by having a fast cutting action without violent recoil. An efficient, low-lift plate valve is intended to assure low air consumption, while the long piston stroke provides a hard-hitting blow. Manufacturer states that the exhaust will not freeze. Gardner-Denver Co.

14—COMBINATION METER

Is designed to measure both watt-hours and thermal kva demand

A new combination watthour and thermal kva demand meter intended for use by electric utilities having rate structures requiring the measurement of kva demand, this meter, designated as the Type IHE-1A, is essentially the same size as a conventional watthour meter; hence it can be installed without increasing size of original installation. It is available in the 50-amp, 250-v, 3-wire, single-phase rating.

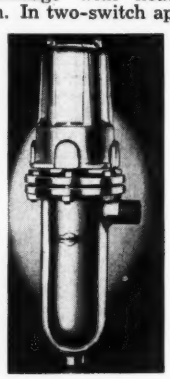
The watthour meter is essentially the same as the I-50 meter, announced last year, except that rotating element is of conventional ball-bearing type. The thermal demand meter unit consists of the thermal unit, current transformer, resistance valve, potential transformer for exciting the heater of the resistance valve, and the driving mechanism, pointers, and scale. Meter and Instrument Divs., General Electric Co.

15—LIQUID LEVEL CONTROL

Is designed especially for heavy duty industrial service

The new Type H Liquid Level Control units feature standard or explosion-proof cover, forged steel body, stainless steel float, and non-corrosive switch unit. Models are available for internal pressure ranges from vacuum to 600 psi and temperatures to 700 F. They are suitable for use with liquids of 0.55 specific gravity and upwards.

Key components of the assembly are magnetic proximity switches containing Alnico permanent magnet elements. The switches, embodying single-pole, double-throw action, are housed in metal cannisters, with no direct mechanical linkage with float part of mechanism. In two-switch applications,



these cannisters are mounted one slightly above the other and opposite each other alongside a sealed, non-magnetic steel tube in which float rod ascends and descends.

This unit is designed for control circuits, level indicating lights and alarms. It is not recommended for direct use with motors. The standard H control is furnished with 1¼ in. male connections. Jo-Bell Products, Inc.

16—125-LB S P VALVES

Feature improved design for greater strength and longer service

Available in globe, angle and check types, the globe and angle valves have a malleable iron handwheel, described as non-heating; identifying nameplate; hexagon head gland designed to eliminate "prying" when repacking; machined repacking seats; solid bronze discs which are renewable on ¾ in. and larger sizes. The deep stuffing box is intended to allow tight joint even when fully packed. Large clearance at end of pipe threads permits tight joint without danger of pipe jamming diaphragm, it is said. Stems are a silicon-bronze alloy claimed to be extremely long lasting.

Lift and swing check valves have similar features. In the lift check, guide lugs on the disc and guide sleeve are provided to assure positive seating. Swing check has two renewable side plugs which serve as bearings for the disc carrier pin, and permit removal of pin from either side, advantageous when valve is installed close to wall. The Lunkenheimer Co.

17—FISH TAPE

Is made for use in all types of conduit, including aluminum

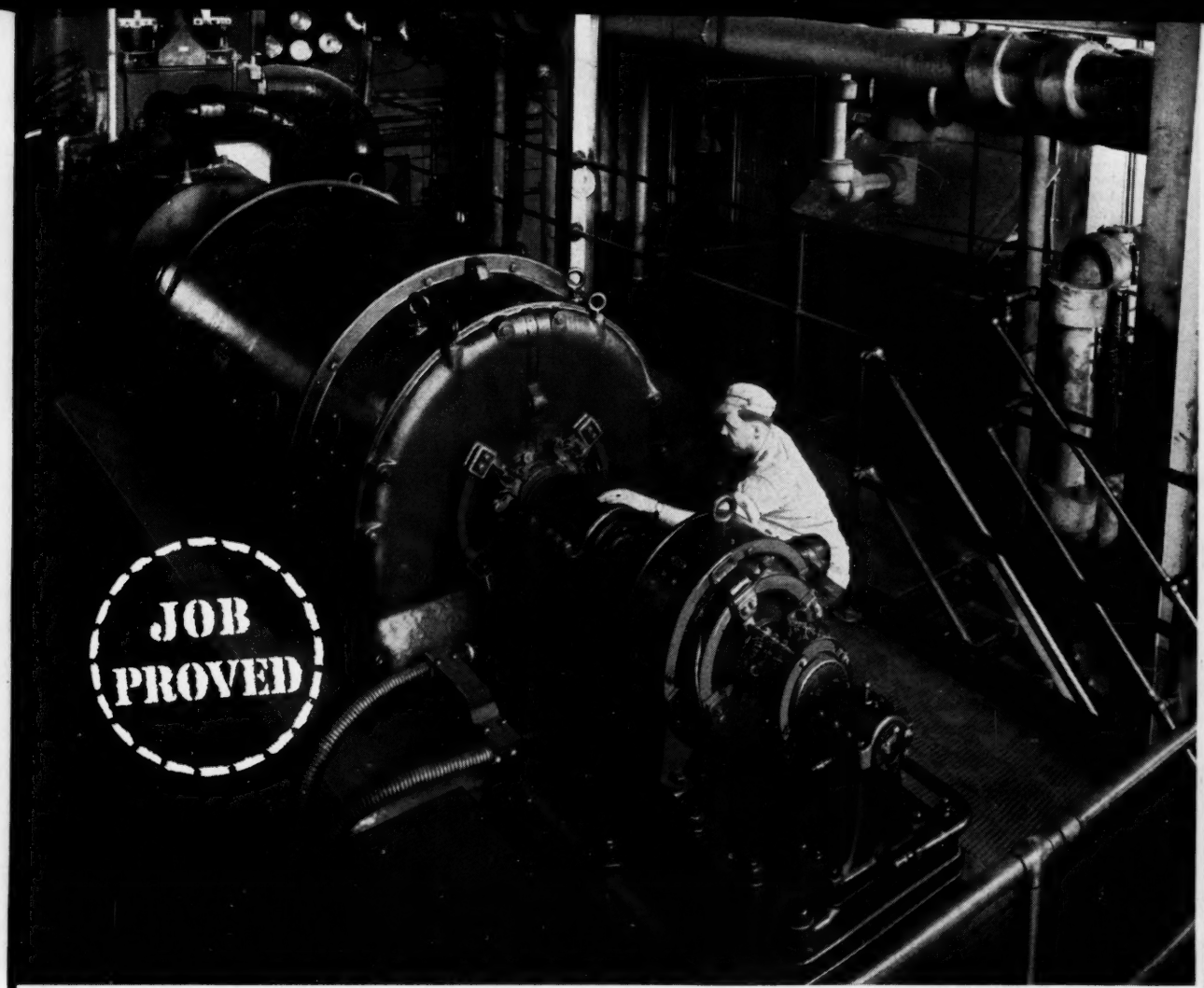
Coil-Flex Fish Tape is extremely flexible, according to manufacturer, and can be pushed or pulled easily though all bends allowed by electrical code. Its round surface is intended to be easy on hands, provide a safe grip, and slide through any conduit. Ends are smooth and round to avoid catching or snagging. Won't damage or cut aluminum conduit, it is claimed.

Coil-Flex consists of a 25-ft length of steel spring, $\frac{11}{32}$ in. in diameter with rustproof inner steel cable. A threaded male fitting on one end and female fitting on the other are provided for ease in joining two or more lengths for jobs requiring longer tape. Can be rolled into a 10-in. dia. circle. When thrown on floor it simply spreads out, manufacturer says, and won't kink, snarl or spring loose. Tested at 400 lb pull. Ideal Industries, Inc.

18—SWITCHING MECHANISM

For ground control of pole-mounted, gang-operated oil fuse cutouts

Here's a pole-base switching mechanism available for 2-phase or 3-phase installations, for control of oil fuse cutouts of any rating. It can be used with cutout installations on poles of any height by an easy field adjustment of the vertical operating member. Metal "on" and "off" nameplates are at the hand-operated lever which permits an operator to determine position of the cutouts from the pole base. All parts are said to be protected from corrosion by a hot dip zinc finish.



PROTECTED BY SUNVIS 916

Turbine Bearings and Journals Corrosion-Free Despite Summer Shutdowns — Oils Like New After 9,000 Hours

Three years ago, a paper mill overhauled a steam turbine. Thereafter, it was planned to operate this equipment on a 'round-the-clock schedule during the six winter months, and completely shut down in the summer. On the advice of a Sun Engineer, the mill charged the circulating system supplying turbine, generator journals, and governor with Sunvis 916. This oil was chosen because of its "Job Proved" ability to prevent rust and corrosion and to give troublefree lubrication for a long period of time.

The management's selection of Sunvis 916 proved to be sound. After 9,000 hours, a laboratory analysis of the oil showed it to be unchanged—comparable to a sample of new oil. Even more important, inspection showed no abnormal wear and no corrosion in bearings and journals, despite the summer-long shutdown.

The turbine has now operated 12,000 hours without oil-change, and it appears that none will be necessary in the foreseeable future.

All oils in the Sunvis 900 series have a high viscosity index, are fortified against oxidation and sludging, and prevent rust and corrosion. Sunvis 900 Oils are the finest lubricants available for turbines, hydraulic systems, and similar applications. For a free, illustrated booklet on Sunvis 900 Oils, write Department PN-6.

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"JOB PROVED" IN EVERY INDUSTRY

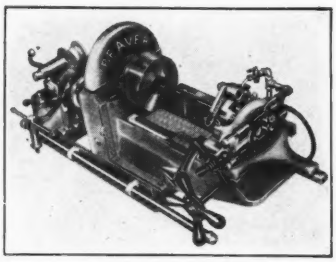
SUNOCO

Manufacturer says mechanism permits ease of switching for primary control of sportslighting circuits, or for fused sectionalizing of lines. The hand-operated lever can be padlocked in either "on" or "off" position to prevent tampering. Transformer and Allied Products Divs., General Electric Co.

19—PIPE AND BOLT MACHINE

Has automatic switch lock and eccentric spool pipe rest

According to manufacturer, the Model-A Pipe and Bolt Machine's new automatic switch lock makes it impossible to start the machine unless the chuck wrench is in its holder. This lock protects workman from injury, and prevents machine from becoming damaged. The new eccentric spool pipe rest—independent from the revolving spindle



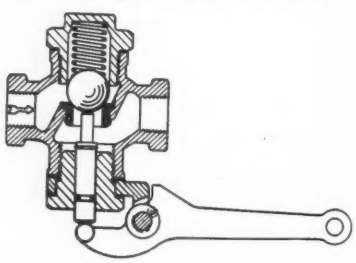
—is intended to absorb the "whip" of long lengths of rotating pipe, and prevent excessive wear on spindle bearings. In addition, it is said to eliminate leaking, "flat-sided" threads.

This machine cuts and threads pipe, ⅛ to 2 in.; with driveshaft and geared tools, its range is increased to 2½ to 12 in. pipe. It cuts off bolts ¼ to ¾ in. and threads bolts ¼ to 2 in. Available in choice of motors, 110, 220, 440 or special voltages; in choice of wheel or knife cutoff, and in 186 different kinds and sizes of dies available from stock. Beaver Pipe Tools, Inc.

20—OPERATING VALVE

Is self-sealing ball type for use on air or water lines

The type BA-1 valve is fitted with a quick-opening lever which may be adjusted to any horizontal position. The ball valve is designed to close tight with inlet pressure and not collect dirt or other foreign matter. Stem is sealed by an O-ring not accessible to tampering or adjustment. It is self-packed by operating pressure when valve is open, permitting flow. Valve is suitable for use with air, or fluids of a non-corrosive nature up to 200 psi pressure and temperatures up to 150 F air and 180 F water where fast, positive action and tight closing are desired.



Valve has cast semi-steel body, integral rubber seat insert, screwed connections; ½ in. size can be bushed to ¼ or ⅜ in. Can be adapted as an operating valve for air whistles, for control of pneumatic cylinders on lifts, hoists, presses, for cleaning air blasts on forging hammers, as a small valve for general machine service and for control of flushing liquids, and as a quick operating shower valve for emergency showers in chemical plants. Leslie Co.

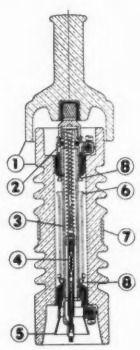
21—SWITCHING-CUTOUT DEVICE

Is enclosed bayonet type, with special safety features

Exceptionally high short circuit interrupting ratings and ability to switch load, magnetizing and charging currents are features claimed for the new Positect. As a cutout, its short-circuit interrupting range extends up to 12,000 amp rms asymmetrical. As a switching device, the insertion or withdrawal of handle-and-tube assembly is said to be all that's necessary for switching distribution transformer load or magnetizing currents, or small capacitor bank charging current. During a switching operation, the arc is confined and interrupted within housing.

Shown in illustration are (1) wet process porcelain handle and housing, (2) gas-operated locking spring, (3) fibre-lined fuse tube, (4) fuse link, (5) arc chute, (6) auxiliary fibre liner, (7) clamp strap for mounting bracket, (8) stainless-steel-spring-backed, silver-plated lower contacts.

A safety feature emphasized is that if unknowingly closed in on a short circuit, the handle-and-fuse-tube assembly does not recoil, and all the discharge is from the arc chute at bottom of housing in a direction away from the lineman. S & C Electric Co.



Cutout

Feeder

22—CHLORINE GAS FEEDER

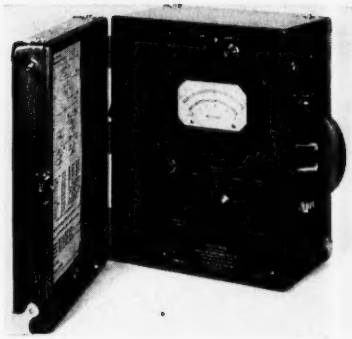
Is built to meter chlorine gas and produce chlorine water solutions

The Chlorinizer is described as an attractive, enclosed unit built for safe, highly accurate operation. A positive chlorine rate indicator with direct-reading linear scale is provided with it. The Chlorinizer is readily adapted to semi-automatic, program, or automatic proportional operation. Conversion from one method of operation to any other may be done in field or plant, according to manufacturer. Builders-Providence, Inc.

23—INSULATION TESTER

Is dual voltage type, for measuring insulation resistance

The new Model 101 Megotron is an electronic rectifier type, dual voltage,



three range instrument for use in measuring insulation resistance of power plant, substation and underground equipment; it is also adaptable to short time tests or dielectric absorption tests.

The instrument operates from 110-130 v, 50-60 cycle lighting circuit and supplies either 500 or 1000 v d-c test voltage. Megohm ranges at 500 are 0.1-5; 3-200 and 15-2000 megohms. At 1000 v the ranges are 0.1-5; 3-200 and 30-2000 megohms. The instrument is 8 by 10 by 6 in. and weighs 16 lb. For carrying, the "off" position of the range selector switch is designed to short circuit the indicating element, thus locking the needle to prevent pivot wear from transportation jolting. J. W. Dice & Co.

24—PHOTOELECTRIC CELLS

Of unmounted selenium, for converting light into electrical energy

These unmounted selenium self-generating photoelectric cells require no external battery or power supply for operation and have found wide use in such applications as photographic exposure meters and illumination meters. Individual cell sizes vary from the rectangular $\frac{33}{32}$ by $\frac{7}{16}$ in. to the round type 1¾ in. in dia. Cells consist of sensitized metal blanks coated with successive layers of selenium and platinum alloys. They are said to be extremely rugged and have unlimited life. According to manufacturer they exhibit no fatigue after continuous exposure to illumination of the order of 200 ft-c.

Among their applications are turning on street lamps at sundown and turning them off at sunrise, opening doors, counting and grading of products on the conveyor line, smoke alarm relays which operate an audible or visible alarm when density exceeds predetermined value, and operating relays for turbidity and color control. International Rectifier Corp.

25—WIRE GUARDS

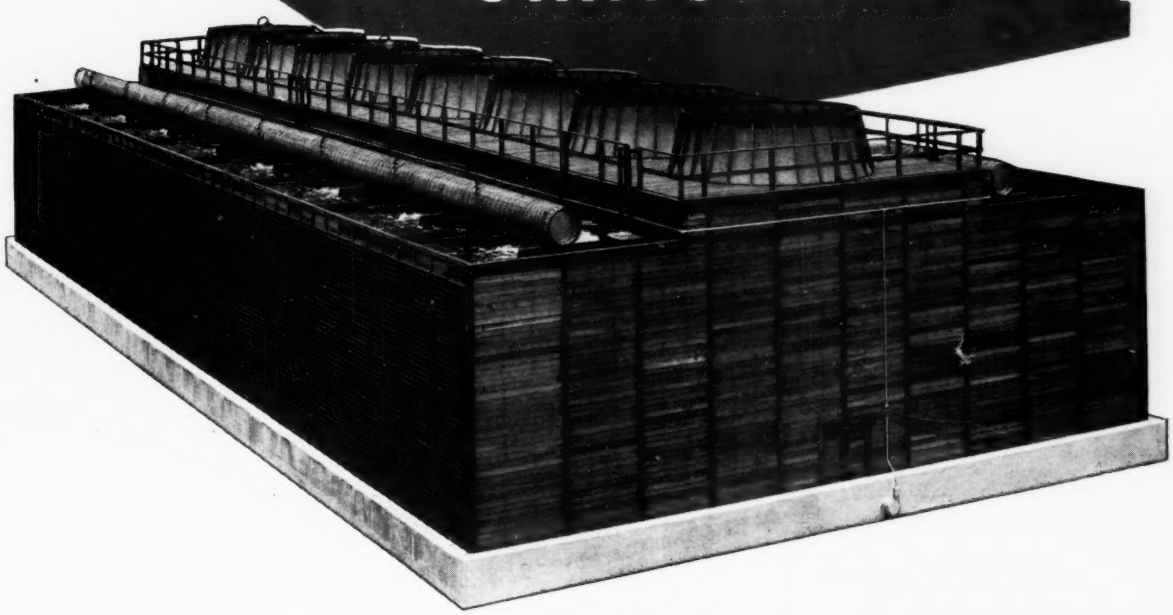
Of plastic, are easily applied without tools or fastenings

Said to be long wearing and speedily installed, "Snapon" wire guards consist of two overlapping U-shaped sleeves of tough, resilient Tenite plastic. Guard is fitted by snapping top sleeve over the bottom one around the wire to form snug fitting, nonrubbing, weather-resistant, water-repellent protection. Made in different sizes for wires of varying standard dimensions and in 6-ft lengths which may be cut. Extra footage is gained by applying guards in continuous overlapping lengths.

According to manufacturer, the plastic guard increases dielectric strength

control SLIME and ALGAE...

SANTOBRITE



Santobrite—Monsanto's Sodium Pentachlorophenate, Technical—offers you these advantages for elimination of slime and algae in cooling water systems:

1. Maximum control of algae and slime-forming organisms.
2. Requires no special feed equipment (merely add to circulating water at any convenient location).
3. Compatible with other chemical treatments given cooling water.
4. Non-corrosive to metals.
5. Easy to apply in powder, briquettes or new dustless pellet form (for those who find Santobrite dust bothersome).
6. Readily available at reasonable cost.

Santobrite provides an economical means of maintaining peak efficiency in your cooling operations... For more detailed information, send for a copy of Monsanto Technical Bulletin O-15. MONSANTO CHEMICAL COMPANY, Desk F, Organic Chemicals Division, 1765 South Second Street, St. Louis 4, Mo.

SANTOSITE...

Controls oxygen corrosion in boiler systems

By removing all traces of residual oxygen, Santosite makes possible economical control of oxygen corrosion in boiler tubes and other steam generating equipment. For detailed information on the Santosite treatment, ask for a copy of Monsanto Technical Bulletin O-26.

Santobrite, Santosite: Reg. U. S. Pat. Off.

MONSANTO
CHEMICALS AND PLASTICS

MONSANTO CHEMICAL COMPANY
Desk F, Organic Chemicals Division
1765 South Second Street, St. Louis 4, Missouri

Please send me: ( ) Technical Bulletin O-15 on Santobrite; ( ) Technical Bulletin O-26 on Santosite for boiler feed water.

Name_____ Title_____

Company_____

Address_____

City_____ State_____

SERVING INDUSTRY...WHICH SERVES MANKIND

of the wire, protects it from abrasion by tree branches, eliminates arcing and burning at point of electrical stress, and breakage from braid to ground. Since Tenite is light in weight, it imposes little extra drag on the wire, it is pointed out, and the overall diameter of the wire is only slightly increased by the Tenite sleeves. Plastic is flexible to conform with movement of strung wire, but won't creep once it's in position, it is claimed, and sharp blows can't shatter the Tenite or produce craters in it. Tennessee Eastman Corp.

26—REDUCING VALVE

Is intended to handle working pressures up to 6000 psi without shock

The Type E High-Pressure Reducing Valve is recommended for reducing the pressure of water, oil, and compressed air—in a single stage to 250 psi or to within 20 per cent of initial pressure. (For lower reduced pressures, the reduction should be made in two stages, the first stage through this Type E and the second stage through a valve for handling working pressures up to 300 psi.)

The body of the Type E valve is forged steel. Internal metal parts are hard chromium plated stainless steel. The one-piece seat stem and removable seat are easily reground and replaced, it is said, and plastic cup washers are specially made for high-pressure service. The pressure on the seat is balanced by a piston above, so that variations in initial pressure have little effect on reduced pressure. A formed packing of special material has been adopted which is claimed to be immune to water, oil and other fluids commonly used in hydraulic machinery. The Atlas Valve Co.

27—AMMETER AND VOLTMETER

Is clamp type, for measuring alternating currents and voltages

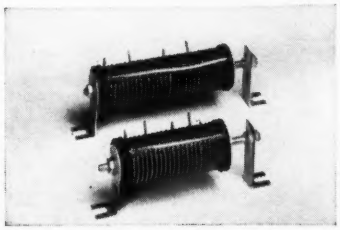
This new a-c clamp ammeter and voltmeter has five current ranges up to 1000 amp, and three voltage ranges up to 700 v. Known as Model 633 Type VA-1, this instrument is designed to measure without interrupting electrical service. A-c measurements are made by placing the heavily-insulated, trigger-operated clamping jaw around the conductor. Jaws accommodate conductors, bare or insulated, up to 2 in. dia. Voltage measurements are made by connecting a set of clip-on voltage leads (6-ft leads supplied) to line, and to screw-type terminals recessed in side of meter.

Current and voltage measurements can be made almost simultaneously by rotating thumb-selector switch to either the ampere or volt position. A pointer stop is provided to show motor-starting currents. To prevent shorts when measuring current on bare conductors, the jaws are insulated with tough rubber sleeves. Operation of jaws is said to be simplified by the single positive-acting trigger, which can be operated by one hand. Instrument has a rated accuracy within 3 per cent of the full scale range (this applies to each of the eight ranges) when used on frequencies between 50 and 70 cycles. Weston Electrical Instrument Corp.

28—RECTIFIER CELL

High voltage selenium type, it permits use of smaller stack

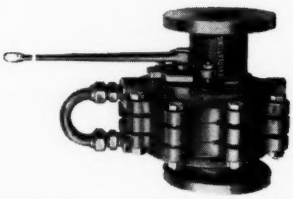
Designed to permit the use of a smaller stack to achieve the same wattage output, this rectifier is rated at 18 v d-c output, a 50-per-cent increase over low voltage cells. The new high-voltage cell can be used in rectifier stacks for installations where space is limited and where stack will not be required to operate continuously 24 hr daily for long periods. An evaporation process which provides a uniform coating of selenium on each cell is used to assure uniform characteristics of operation in electrical equipment requiring d-c power. Lighting and Rectifier Divs., General Electric Co.



29—STEAM JACKETED VALVES

Are developed for the transmission of viscous materials

These valves are intended for use on viscous materials which congeal or harden and won't flow at ordinary temperatures. In these valves, the disc slides across the ports in a rotating self-clearing action actuated by a quick-operating lever. When wide open, the valve offers straight through flow with unrestricted passage. All parts move in a parallel plane so mechanism is non-wedging.



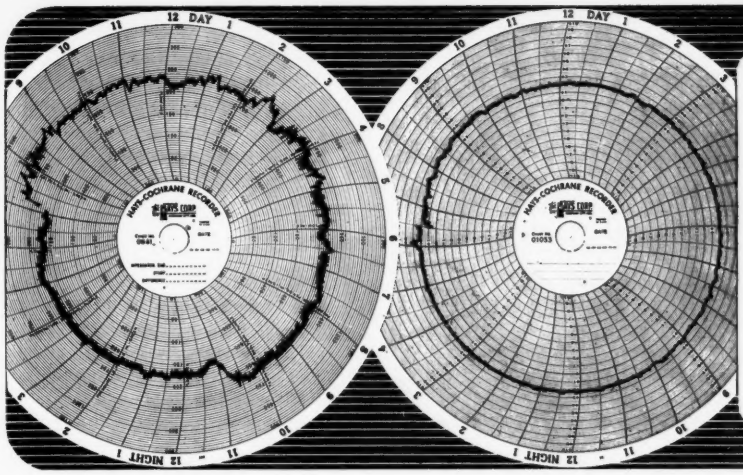
Jacket space surrounds port openings as well as body to provide extensive heating surface and correct temperature to insure fluidity of materials being handled. The steam or other heating medium can be connected to jacket at either side of valve. Expansion and contraction due to changes in temperature don't affect valve's operation or leak-proof qualities, it is said. Available in 2, 3 and 4-in. sizes, for 125 psi line pressure and 125 psi jacket pressure. Everlasting Valve Co.

30—SECONDARY CAPACITOR

Economical; for residential feeder circuits

A new 3-kvar secondary capacitor, designed for use on 240-v house feeder circuits where use of such devices could not previously be justified for economic reasons is available. This capacitor, priced at approximately 60 per cent of the price per kvar of the previously available 240 v capacitors, is said to provide attractive benefits. These advantages include released distribution transformer capacity, reduction in distribution transformer and secondary losses, and reduction in voltage drop between first and last customer on feeder when capacitors are located only on secondaries furthest out on the feeder.

Rated at 240 v, single phase, 60 cycles, the new capacitor is a complete redesign of existing models. It features a hermetically sealed aluminum alloy case which has two stud type porcelain bushings. Small in size, approximately 7 in. by 10 in. by 20 in., and light in weight, the unit is designed for "on-the-pole" mounting with a key-hole slot in the bracket at the top and a slot at the bottom. The capacitor is said to meet NEMA shunt capacitor standards. General Electric Co.



BOILER
Riley Type RP, 4-drum bent-tube

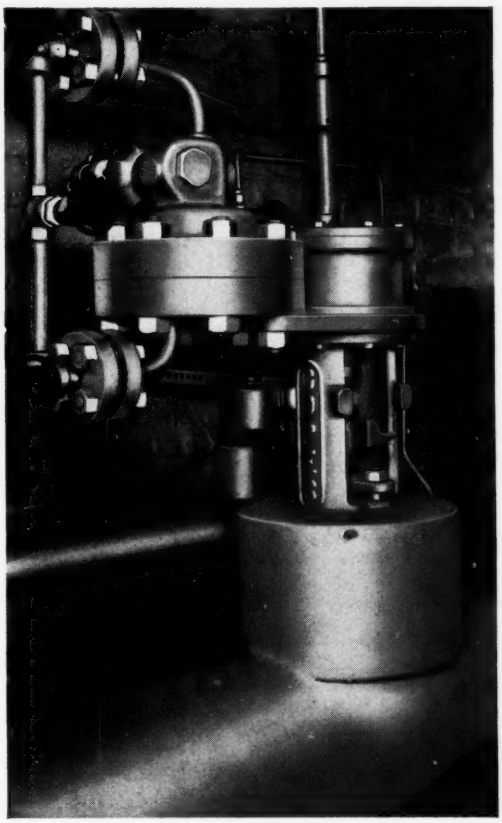
MAXIMUM CONTINUOUS RATING
225,000 pounds per hour

STEAM CONDITIONS
660 psi, 750 F at superheater outlet

LEVEL CONTROL
COPES Flowmatic Type R-O Regulator with 5-inch relay-operated control valve, actuated by the resultant of steam-flow and water-level influences

COPES FLOWMATIC TYPE R-O*

HOLDS CLOSE BOILER WATER LEVEL WITH CONSTANTLY-SWINGING LOADS



*R-O means relay operation, with the COPES Valve built to absorb pressure drops of 2000 psi or more, if necessary under abnormal operating conditions. The flow-responsive element is mounted on the valve, with direct mechanical link to the level-responsive element or COPES Thermostat.

If your boiler loads are constantly swinging, take a tip from this well-known industrial plant. Here load fluctuates constantly, swings averaging 10,000 pounds per hour. With total load range from 150,000 to 265,000 pounds per hour, the total water-level variation was no more than plus-or-minus one inch.

You'll find the complete story of this important installation in Performance Report 485. Write for your copy. See for yourself what results you can expect when you entrust the feed control of your modern boilers to experienced COPES Engineers.

NORTHERN EQUIPMENT COMPANY
692 GROVE DRIVE, ERIE, PENNSYLVANIA
BRANCH PLANTS in Canada, England, France, Austria, Italy. *Representatives everywhere.*

COPES

Headquarters for . . .

Boiler Feed Water Control . . . Excess or Constant Pressure Control, Steam or Water . . . Liquid Level Control . . . Balanced Valves . . . Desuperheaters . . . Boiler Steam Temperature Control . . . Hi-Low Water Alarms.

PENNSYLVANIA POWER Picks YARWAYS FOR HIGH PRESSURE TRAPPING OF SOOT BLOWER PIPING

Add the name of Pennsylvania Power Company to the list of utilities using Yarway Integral Strainer Impulse Steam Traps for high pressure service.

On this installation at the modern Newcastle Plant Yarway traps are doing a good job . . . as they are in hundreds of high pressure plants including some of the hottest steam lines in the country. Yarway Super Pressure Traps meet all requirements on pressures up to 1500 psi. They have ample capacity when system is being "warmed up" . . . yet will handle relatively small amounts of high temperature condensate without losing prime. In presence of dry or superheated steam the trap valve closes.

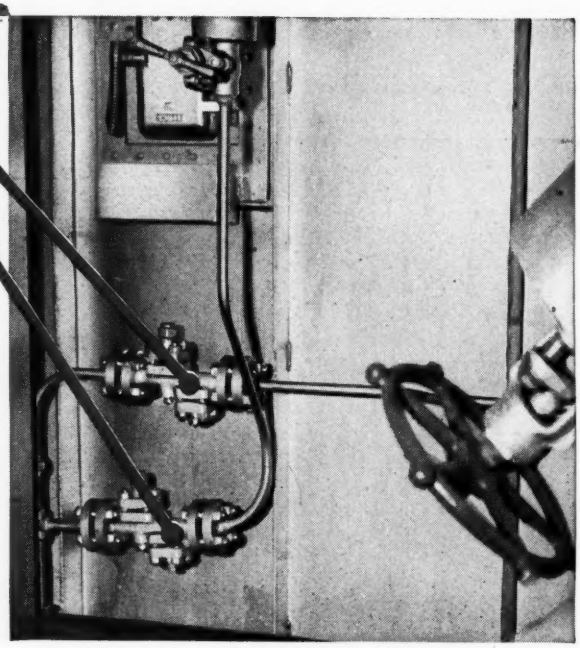
Small size simplifies installation. No special supports needed. Integral strainer feature protects against scale and rust, makes maintenance easier.

Yarway Integral Strainer Traps have the same simplicity of operation as standard Yarways—only one moving part, a small stainless steel, heat-treated valve.

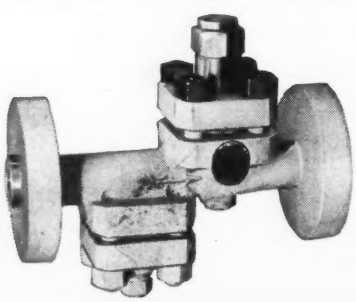
Over 600,000 Yarway Impulse Steam Traps have been bought in only 12 years.

Write for Yarway Steam Trap Bulletin T-1739.

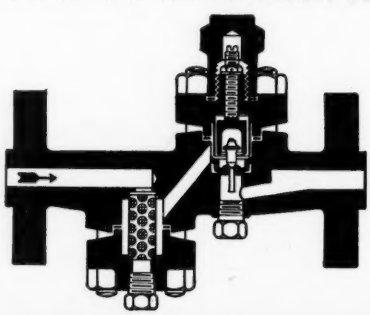
YARNALL-WARING COMPANY
114 Mermaid Ave., Philadelphia 18, Pa.



Yarway Super-Pressure Integral Strainer Impulse Steam Traps installed on soot blower drain lines at Newcastle Plant.



The Yarway Super-Pressure Integral Strainer Impulse Trap. Trap valve seats on solid stellite insert in welded-in stainless steel seat ring.



YARWAY IMPULSE STEAM TRAP

LETTERS TO THE EDITORS

WAGES

GILBERT LINDGREN'S letter, headed "Wage Rates," in the April issue of POWER GENERATION, is timely and much appreciated. It is sad to note, however, that for millions of mechanics and craftsmen, tied securely to union pay rates and Civil Service schedules, Mr. Lindgren's is a voice crying in the wilderness. For these men, the discussion is bound to remain strictly academic. All ambition, skill and energy is negated by set rules. All men in the shop are reduced to the mass level, and while the incompetent are rewarded, the competent will suffer.

I agree completely with Mr. Lindgren that there should be wage discrimination, and that real craftsmanship should be rewarded. But to bring about that situation is something else again.

In small towns, not yet polluted by unions (please do not edit) the craftsman can gain employment with a small operator, be he garageman, small contractor, or what not. Thus the mechanics immediate boss can judge the amount and quality of the worker's output, and adjust his pay accordingly. Another "out" is the ownership of a small business or shop. Here the craftsman can set his own price on his own work, to suit the current and local economic situation, customer's ability to pay, and whatever other facts may suit his fancy.

It is obvious, however that the economy of this country cannot do without enormous shops of the mass production type. Some evils are inherent in shops of this kind, and the even wage is one of them.

Practically everyone has enough pride in his make up to compel him to desire to be outstanding in some respect, preferably in his own chosen trade or profession. Various "suggestion box" and "Merit Award" systems have been set up, in an endeavour to foster this understandable feeling, and thus bring about improved individual and shop morale. However, it cannot be denied that a suggestion is an implied criticism, and very often suggestions are not received in the same spirit in which they are given.

Suggestions are generally sent to the department which they most concern. It is possible and darned probable that a suggestion will pointedly indicate a glaring oversight or rank incompetency on the part of the department heads. The suggestion is then refused, with thanks, as being unworkable.

Piece work plans may not fit in with the conveyor type of assembly line. Who wants two engines in one car? But in supply companies, piece work systems can well be used, and the fast, competent worker be rewarded. To get results, you want to put a man in business for himself. For work such as piping, wiring, auto mechanic, piece work is practical. Or you can call it an "incentive system." On production screw machine and grinder work, for instance, "work handled" divided by "spoils" would give a percentage to work on.

Yes, Mr. Lindgren, something should be done, but how?

Pawling, N. Y. WILLIAM SHEFFER

ADDITIVES

The article on Fuel Oil Additives in the February issue, as indicated in "Letters to the Editor" in the April issue, excited considerable comment and requests for further information. A letter from A. A. Berk who is Supervising Chemist at the Boiler Water Research Section, of the Bureau of Mines experiment station at College Park, Maryland, asked for reference sources concerning the article in the February issue. Mr. Berk's request was sent on to Paul F. Schmidt who wrote the article on Fuel Oil Additives in the February issue and since his reply to Mr. Berk's Letter is of interest, we requested Mr. Schmidt's permission to publish it for the benefit of other readers. Mr. Schmidt is chemist with the Allied Oil Co., Inc., Cleveland, Ohio.

Dear Mr. Berk:

WHEN WE talk about sludge in fuel oil storage tanks, we fail to realize the so-called sludge can be quite a mixture. Some of these ingredients are listed below:

1. Gum, resins, asphaltenes
2. Free carbon
3. Water
4. Mud, sand, stones
5. Wood splinters, twigs
6. Tank scale or rust, gasket material, pump hose shreds
7. Rags and rag shreds

All of these contaminates may not be present at one time, but sometimes a majority of them will be in the tank. Therefore, no matter how good a solvent a fuel oil additive may be, it will not do away with all the above listed materials.

Items 1 and 2 are due to the oil itself and may be present when delivered or accumulated after a period of time. Those additives which are good solvents will have no trouble working or attacking the material listed on item 1.

If a storage tank is perfectly clean and the oil is clean when delivered, it has been possible by the addition of these fuel oil treatments, to prevent formation of this type of sludge, thereby keeping and maintaining a clean tank. If this type of sludge is already present in the tank, continued use of fuel oil treatments will *slowly* dissolve it leaving a clean bottom.

The best method is to add the treatment when pumping in the oil. Agitation may be necessary but it should be done with a little caution, because if the amount of sludge is large and composition unknown, the agitation will cause a too great suspension in the oil, which will be drawn into the lines and block the screens. It is best to let the treatment do all the work.

If a sludge is composed of most of the listed items, some will dissolve and disappear, but there will also be some left. So to obtain 100 per cent efficiency from a fuel oil additive, there are certain conditions that must be present. If the sludge is of such a composition as to cause trouble even with an additive present, the storage tank should be pumped out.

One operator had an accumulation of sludge and began to use an additive, but claimed that it kept the sludge in suspension to such a great amount, that it blocked his strainers, so he quit using it. The real cause was that when the oil was delivered by a truck, it agitated his tank so badly as to suspend the sludge. He blamed the fuel additive, but other conditions were to blame.

Another operator had a mixture of sludge which included stones, wood splinters and rag shreds. A fuel oil additive supplier tried to sell him an additive for his oil, but when the operator wanted a guarantee on that particular tank, the supplier wisely refused. The reason is obvious, as the operator was already pulling that insoluble type of material through his lines, and blocking the screens.

I have seen, when gaging a storage tank, a brown-muddy looking sludge on the bottom of the gage stick. After use of treatments for 7 days, this sludge had disappeared. This is one of the observations expressed by various operators.

Fuel oil additives on the market today are many, and some of them must be tested extensively to find their true value, but again some are easy to check and fortunately it appears easiest to check the bad ones, than the good ones. Unless you have a complete combustion laboratory at hand, I don't believe you can test 100 per cent a fuel oil additive, and claim its true value. There are a number of tests which can be run

(Continued on page 76)

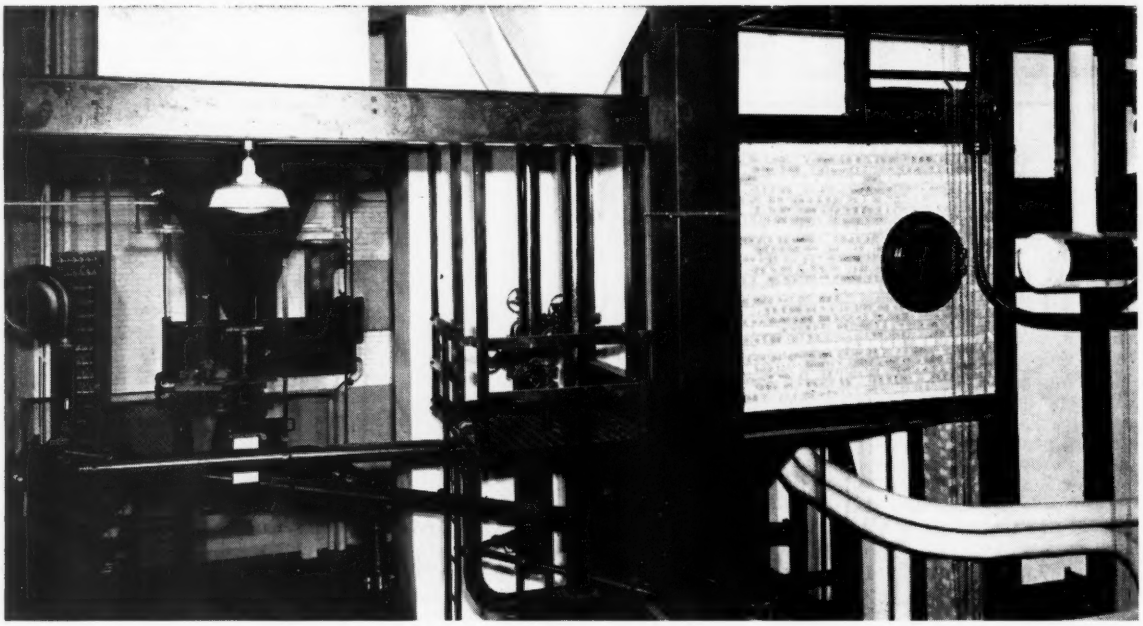


Fig. 1. View of typical industrial plant fly ash collection and reburning system. At right, bottom drum and furnace of 3-drum bent-tube boiler. Upper left, fly ash collector with discharge hopper, with rotary dust valve and connections so fly ash can be stored in hopper and ejected into ash conveying system or fed directly to cinder return system. This transports cinder and fly ash back to furnace by air pressure furnished by small fan mounted on wall at extreme left. (Western Precipitation Corp. photo)

Reburning Stoker Fly Ash

Describes in detail methods used in recovering and reburning fly ash from anthracite firing on chain grate stoker and bituminous coal firing with spreader stoker . . . In one anthracite-fired unit, reburning of cinder and fly ash increases overall boiler efficiency 2 to 3% . . . After dust collectors installed, ID Fans run without rotor maintenance for 6 years; formerly complete new rotor every 4 or 5 years . . . Details of anthracite cinder and fly ash reinjection and reburning . . . On bituminous-coal fired unit, similar advantages . . . Details of reburning method with a spreader-stoker-fired unit

By **C. H. BEAN** Supervising Engineer of Power Plants, Calco Chemical Div., American Cyanamid Co.

EXPENSIVE EQUIPMENT of modern, stoker-fired boilers compels their operation at high ratings in order to justify their investments. Air is pumped into the furnaces with power-driven, forced-draft fans to support combustion; and the resulting gases are sucked out of the furnace and drawn in series, at high velocity, through boilers, superheaters, economizers and air heaters by power-driven, induced-draft fans, which in turn discharge through stacks to atmosphere. Water-cooled furnaces permit heat generation and heat absorption at rates not commonly known 20 years ago.

The result of handling such large volumes of air and gas through the units literally tears loose from the fuel bed, and carries through the boiler proper and its heat traps, very considerable quantities of unburned and often quite abrasive, small-sized fuel particles. These, if not collected and reinjected into the fire to complete their combustion, would not only constitute a serious waste of coal but also would create a nuisance by the rain of partly-burned fuel on the surrounding buildings and the nearby landscape.

Anthracite Stoker Firing

Number 3 buckwheat, sizing between 3/16 in. and 3/32 in. and No. 4 buckwheat sizing between 3/32 in. and 3/64 in. are the two anthracite stoker fuels offering the best return on purchase price and are the ones most commonly used to generate steam in anthracite-burning industrial units and, in some cases, in public utility boilers. Such fuel can be burned to advantage on chain grate or traveling grate stokers serving boilers up to a maximum output of around 250,000 lb of steam per hour. Much larger anthracite-burning public utility plants burn the fuel in pulverized form. The comments below will be confined to the stoker-fired units.

Even the smaller-sized anthracite —that is, No. 4 buckwheat—can be burned at rates not exceeding around 10 or 12 lb of fuel per sq ft of effective grate area per hr without creating undue fuel loss or causing undue fly ash nuisance; but such low rates of combustion would not effect a suitable return on expensive boiler and auxiliary equipment. Usually such units are operated at an average fuel consumption of about 30 lb per sq ft of effective grate surface, and on up to 50 lb or more in extreme cases. The higher the percentage of undersize in such

fuel and the higher the rate of combustion, the higher the percentage of the fuel that will be torn loose from the fire and carried at high velocity through the boiler setting.

Difference Between Cinder and Fly Ash

Such fines picked up by the gas stream might be classified into two divisions: the coarser material that some people call "cinder"; and the much finer particles called "dust." Cinder is usually collected in hoppers under the last passes of boilers, under air heaters and under economizers, or at other points where there is an abrupt change in the direction of the gas flow, or where velocities may be lowered to such an extent that entrained solids will drop out. From such collection hoppers, these fines may be transported by various means back to the furnace for burning out their carbon content. The carbon content of the "cinder" runs high, in the neighborhood of 80 per cent to 87 per cent.

Heating value of such material is really higher, as a rule, than that of the fuel from which it came, for the reason that the raw fuel usually contains around 10 per cent moisture, whereas the fines, of course, have had this moisture liberated by the heat of the furnace. They are comparatively coarse, often running largely over 50 mesh. The recovery and refiring of such fines may effect a saving of from 8 per cent to 15 per cent or more of the fuel from a hard-pressed unit. At lower rates of steaming, possible recovery is, of course, much less.

The more finely-divided material often referred to as "dust" and by some as "fly ash," cannot, as a rule, be collected in the traps and hoppers usually provided to collect the cinder. It continues on through the setting and, unless collected by special apparatus, will eventually escape out the stack and cause a decided nuisance and a considerable economic loss. Such material runs largely through 100 mesh in size and carries a considerable part of its volume finer than 200 mesh. Its carbon content will run lower than that of the cinder as will also its weight or volume.

Dust or Fly Ash Collection and Reburning

Collection and refiring of dust from a unit operating at good load represented by the combustion of, 30 to 40 lb of fuel per hr per sq ft grate area, may effect a gross saving of anywhere from 1 per cent to 8 per cent, usually averaging around 2 per cent or 3 per cent of the heating value of the coal fired to the stoker. This dust, or fly ash, being such finely divided material, must be collected by special apparatus.

The electrostatic dust collector quite often used in large public-utility stations burning pulverized bituminous coal does not seem to be practical for the smaller anthracite units, and on such units the recovery

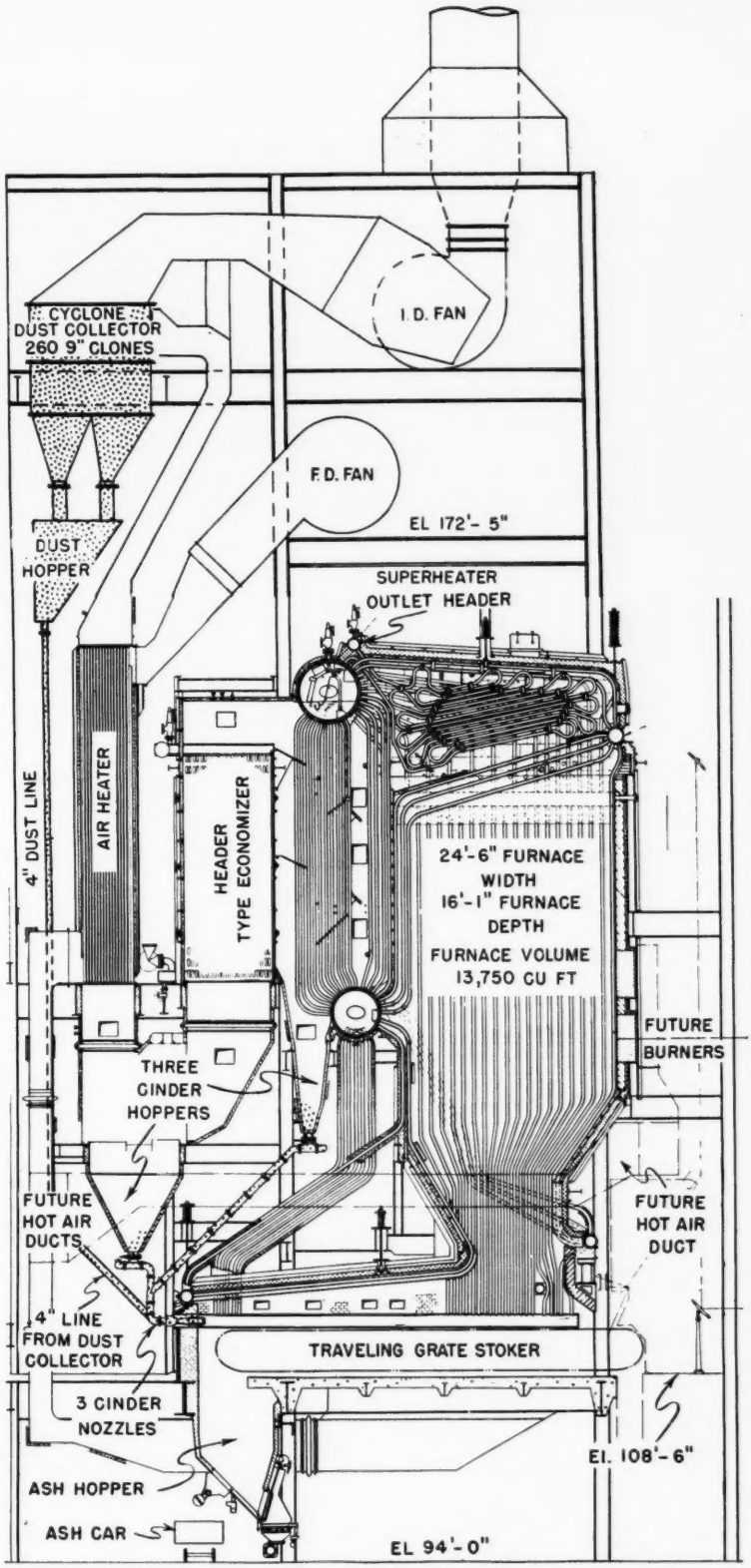


Fig. 2. Vertical cross-section of 200,000-lb-per-hr, 900-psig, 750-F steam-generating unit fired by anthracite, with its heat traps, collecting hoppers, dust collector and re-injection apparatus. Engineering Data: Efficiency, 88%; Heat Release, 21,300 Btu per cu ft per hr; Heating surfaces—boiler, 14,860 sq ft; air heater, 22,000 sq ft; economizer, 10,300 sq ft

is usually effected by means of cyclones—that is, centrifugal devices for separating the solid material from the gas.

Many schemes have been resorted to for returning the collected dust and cinder to the furnace, varying all the way from 1) dribbling such material by gravity to the grate through holes or slots in the top of the rear arch of the furnace or 2) resorting to air transport induced by steam jets or by forced air, to 3) collecting the material and mixing it with the raw fuel and feeding it back onto the stoker along with the regular coal.

A Specific Anthracite Burning Installation

At the plant with which the writer is most familiar, collected cinder has been transported from the collecting hoppers and reinjected through the rear wall of the furnace, over the grate and back into the fire by means of steam-jet-aspirated air. This system has been in operation for over 17 years and has given general satisfaction. Later on, when we learned to use dust collectors to take the fly ash out of the gases that otherwise would escape to the stack, such material was also transported back to the furnace by means of steam-jet-aspirated air.

This latter operation has been in use for the past six years with definite results in clearing the atmosphere around the boiler plant of what previously had been a fly ash nuisance as well as increasing the gross over-all efficiency of the boilers so served by some 2 per cent to 3 per cent.

Another benefit derived from the installation of dust collectors has been the almost complete elimination of fly ash erosion of the induced-draft fans. Before the use of dust collectors, it was common practice—in fact, in some cases a necessity—to weld the paddles of such fans two or three times a year and possibly put in new paddles about once a year and complete new rotors every four or five years. Our largest unit, with a dust collector between the air heater and the I. D. fan and steaming at a maximum of 200,000 lb per hr, has had its induced draft fan in practically constant operation for over six years without the necessity of any welding or replacement rotor maintenance.

Cinder and dust unless put through properly designed equipment can cause, and has caused, much damage by cutting the tubes of boilers, superheaters and economizers. It is the writer's opinion that the ideal anthracite unit, if not too expensive, would include a single-pass boiler to avoid abrupt changes in direction of the gas flow within the boiler proper and would also include a dust collector between the boiler and the economizer in order to protect the latter from destructive, erosive tube cutting.

Bituminous Coal Stoker-Fired Boilers

Unless crowded to very high ratings, the burning of bituminous coal on either underfeed or traveling grate stokers does not usually create a serious fly ash problem. Nowadays, spreader stokers are quite generally replacing chain grate and underfeed type stoker firing for bituminous-coal burning boiler units, of from 20,000 lb per hr up to a maximum of around 250,000 lb pounds steam of capacity.

The spreader can, however, create a nuisance for the reason that it breaks up the fuel into comparatively fine particles and distributes it by means of rotors or jets over the entire area of the grate. The fire is thin, and combustible gases tend to distill off in vertical streams with bad stratification of air and combustible gas unless rather violently disturbed by the injection of over-fire air, which thoroughly mixes the gases and causes bright, smokeless combustion.

Movement of many fine particles torn off the thin fire on the grate, or deliberately thrown into the gas stream by means of the spreader rotors, does not permit time for all the particles to be completely consumed; and very considerable quantities, especially when steaming at high ratings, are picked up by the combustion gas stream and carried through the settings in a manner similar to the anthracite-burning process. This would involve some fuel loss and cause an objectionable fly ash nuisance unless it were collected and returned to the furnace for burning out combustibles.

Reburning Bituminous Fly Ash

Spreader stokers burning bituminous coal can be operated quite satisfactorily with burning rates as high as 50 or even 60 lb of coal per sq ft of effective grate area per hour, but this takes place with the entrainment, as before mentioned, of large quantities of incompletely-burned fuel. Sizing of the particles picked up by the gas stream may be somewhat larger than those carried in the anthracite setting, but the carbon content is usually much lower. Unless collected and burned by reinjection to the furnace, however, such fines and dust can easily constitute a loss varying from 1 per cent to 3 per cent.

Therefore, in most cases where fuel is being burned at rates much over 10 or 12 lb per sq ft grate area, both fines and dust, are collected and returned to the fire.

This is usually effected by air transport, much in the same manner as the return of fines from an anthracite unit, with this exception—that since turbulence air must be supplied to the furnace, such fan-propelled air is often used as a means of transporting at least a part of the fly ash back to a point where it can be burned. Sometimes a portion of the discharge of the forced-draft fan is diverted through nozzles to create air transport and draw such material to the furnace and project it across the fire.

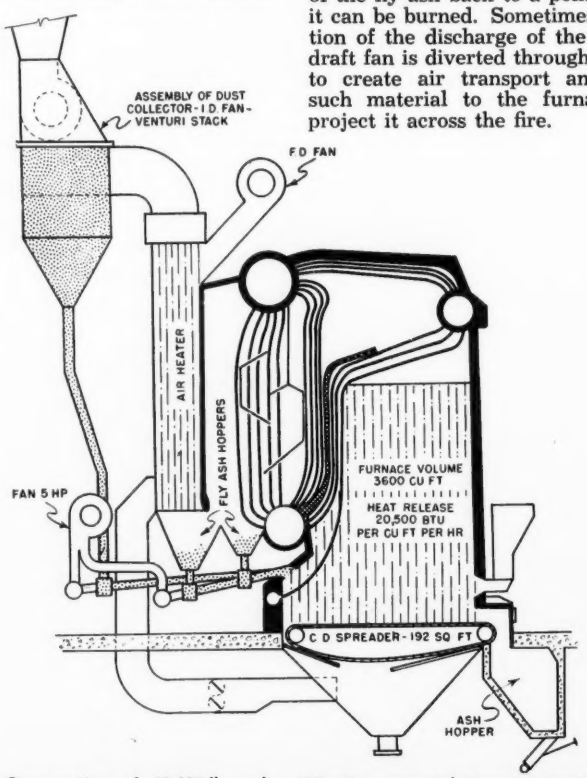

ASSEMBLY OF DUST COLLECTOR - I.D. FAN - VENTURI STACK
F.D. FAN
AIR HEATER
FLY ASH HOPPERS
FAN 5 HP
FURNACE VOLUME 3600 CU FT
HEAT RELEASE 20,500 BTU PER CU FT PER HR
C.D. SPREADER - 192 SQ FT
ASH HOPPER

Fig. 3. Cross-section of 80,000-lb-per-hr, 150-psig, saturated-steam-temperature steam generating unit, fired with bituminous coal by continuous-ash-discharge spreader stoker. Fly ash collecting and return system is integral part of installation and is kept operating continuously as long as boiler is steaming

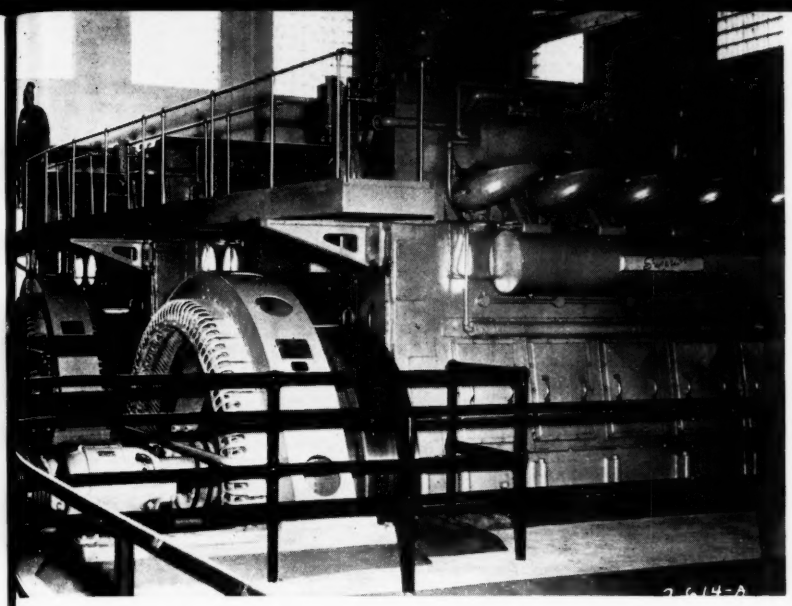


Fig. 1. Three 1440-hp supercharged Diesels driving 1000-kw generators in new municipal power plant at Petoskey, Mich.

Three 1440-hp Diesels Quadruple Petoskey Hydro

TO SUPPLY POWER for Petoskey, a small industrial city of 6000 and summer resort on Little Traverse Bay in Northern Michigan, a new $570,000 plant with three 1440-hp supercharged Superior Diesels, driving General Electric generators capable of developing a total of 3000 kw, has recently been built. Each of these three engines develops more power than the city's three hydro units combined under full water head.

The three Superior diesels are equipped with turbo-superchargers of the Elliott Buchi type, which are driven by the engine exhaust and turn centrifugal blowers that supply all combustion air under pressure. Turbo-supercharger operation is fully automatic.

The lubricating oil system is of the force-feed, dry sump type with a single pump. Fuel oil is obtained from Michigan oil fields by either tank car or motor transport. Four 25,600-gal tanks, buried outside the building, hold a two-months supply of oil. Oil from these tanks is pumped by fuel oil transfer pumps under automatic float control, through strainers to the 250-gal day tanks.

Engine jacket water is zeolite softened water from city lines. It is cooled by heat exchange with raw cooling water brought from the flume of one of the hydro plants. This water also cools lubricating oil.

Switchgear includes panels for each distribution circuit, the power house lighting panel, three Diesel generating unit panels, incoming panels from hydro plants, totalizing panel for total outgoing load, and a swinging synchronizing panel for use when Diesel units are paralleled with the hydro plants.

Power distribution is made at 2450 v direct to pole line transformers that step down voltage to 115/230 v for consumer use. There are six circuits for consumer current and three for street lighting.

The new power plant was engineered by Burns & McDonnell Engineering Co. Contractor for the building was Peterson and Westberg; The R. V. Leary Co., was in charge of the Diesel engine installation and all mechanical work; Clement Electric Co., had the electrical contract.

PRINCIPAL EQUIPMENT
New Municipal Diesel Plant, Petoskey, Mich.

Diesels—Superior Engine Division, National Supply Co. (Three 8-cylinder, supercharged, 14½-in. bore, 20-in. stroke, 1440 hp. at 360 rpm.)
Superchargers—Elliott Co. (Buchi turbocharger)
Generators—General Electric Co. (Three 1000 kw.)
Switchgear—General Electric Co.
Governors—Woodward Governor Co.
Silencers, intake and exhaust—Maxim Silencer Co.
Injection pumps—Bendix-Scintilla Magneto Div.
Fuel oil filters—Purolator Products, Inc.
Lubricating oil filters—The Hilliard Corp. (Type FA-3)
Lubricating oil strainers—Purolator Products, Inc.
Starting air compressors—Quincy Compressor Co.
Heat exchangers—Bell & Gossett Co.
Lubricating Oil Coolers—Graham Manufacturing Co., Inc.
Exciters—General Electric Co.
Pyrometers—Alnor, Illinois Testing Laboratory
Alarms—Superior Engine Div., National Supply Co.
Temperature regulators—Minneapolis Honeywell (Brown)
Jacket water circulating pumps—Worthington Pump & Machinery Corp.
Fuel oil meters—Niagara Filter Corp.
Fuel oil transfer pumps—George D. Roper Corp.
Overhead Traveling Crane—Whiting Corp. (15 ton)

Fig. 2. Silencers for intake air entering turbo-superchargers on three 1440-hp Diesels at Petoskey. Superchargers at upper right

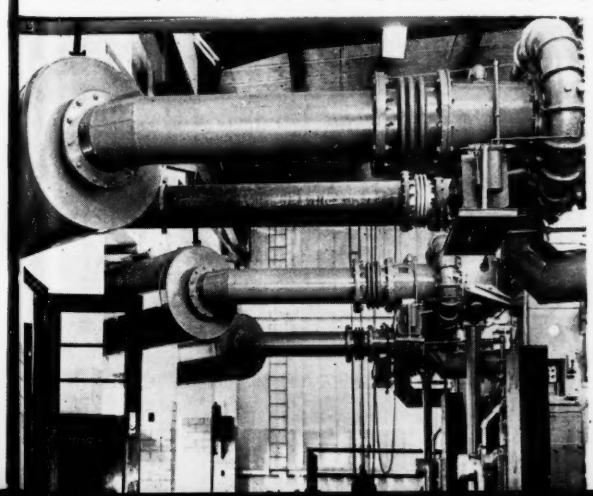
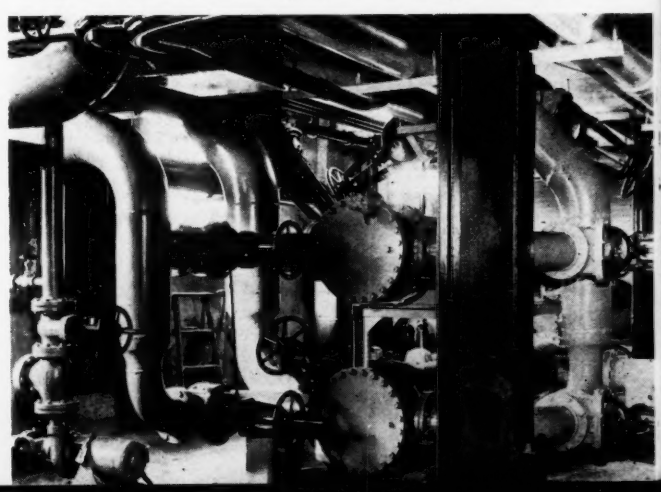


Fig. 3. Heat exchangers for jacket cooling water at Petoskey. Pump at lower left circulates jacket water through unit heaters



PRACTICAL MAINTENANCE TIPS

Forestall Boiler Tube Failures by Using this Scale Thickness Indicator

BY MEASURING scale thickness to 0.001 in. with the indicator described here, a number of power plant engineers are now avoiding costly delays and outages by finding potential cause of failures in boiler tubes and other ferrous tubes, and eliminating the trouble before unexpected tube failures occur. They are checking scale, pitting and corrosion inside boiler and water wall tubes, finding hot spots, reducing maintenance in boilers, economizers, heaters and heat exchangers and determining effectiveness of feedwater treatment. Where boilers are cleaned either chemically or mechanically, it is now common practice to do so when scale thickness reaches some predetermined value. Every user of modern boilers with long tubes whose internal surfaces cannot be otherwise checked should be interested in the method described here.

The scale thickness indicator was developed by H. L. Turner, efficiency engineer for a well-known utility company; and is now in production and on the market. Several utilities and industries have used it successfully for a number of years.

The indicator consists of the equipment shown in Fig. 1. The probe head is an electromagnetic device, which is fed down into the tube from the upper header or drum by means of the graduated steel tape handled by one operator, while a second operator reads and records the scale thickness shown on the indicator for each foot of travel. The steel tape, graduated in feet, shows how far down the tube the probe head is located, holds the head in contact with the tube surface and permits the head to go around the bends.

The probe head is guided through and held against the walls of the tube by guide wheels; and provision is made for rotating and locking the head in various positions for checking pitting on side-wall tubes nearest the flame. The two feet in the probe head bear against the tube and indicate the distance in thousandths of an inch between the feet

Fig. 1. Assembly of the Turner Scale Thickness Indicator, showing electromagnetic probe head; 50-ft graduated flexible spring-steel feed tape; 60-ft flexible electrical conductor; calibration test plates; indicator with Weston or GE movement. Supplied for plugging instrument into any 110 or 120-v, 60-cycle, a-c supply. No. 1 probe heads for tubes under 2 in. I.D.; No. 2 head for tubes over 2 in. Guide arms and wheels take care of ¾-in. I.D. variation for tubes under 3¼ in.

Fig. 2. View showing how probe head of Turner Scale Thickness Indicator is supported by wheels inside tube

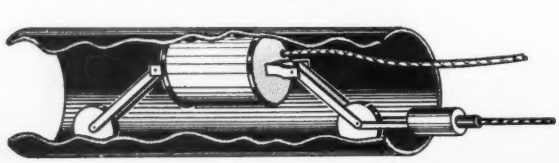


Table showing readings taken by scale thickness indicator in tubes of a 900-psi boiler; tubes lead from East side wall upper main header. Readings in thousandths of an inch. Note how high readings cluster; pitting was evident in cases of readings of 0.010 in. or more. Boiler should have been acid or mechanically cleaned much earlier

Distance in Ft Down From Header	Indicator Reading in Thousandths of an Inch — Tube Numbers in Upper Main Side Wall Header														
	14	15	39	40	18	19	20	21	22	23	24	25	26	27	28	29
1			2	2		4	2	2	2	3	1	2	2	1	2	2
Bend 2			4	3		1	2	4	3	2	0	4	2	2	2	1
3			2	2		4	2	2	1	2	3	3	3	3	2	0
4			2	2		3	2	4	9	2	4	8	2	3	3	3
5			2	2		2	6	3	6	2	3	7	2	2	3	1
6			2	3		2	3	2	6	3	3	4	7	5	3	2
7			1	1		4	3	9	9	7	2	3	7	3	5	2
8			1	1		4	6	6	8	7	7	6	5	8	6	2
9			1	1		5	7	6	7	6	5	5	6	5	6	3
10			1	2		6	8	6	6	8	6	5	7	5	6	3
11			1	4		6	10	7	14	8	7	5	7	5	8	4
12			2	4		10	11	9	20	11	9	8	9	7	9	7
13			4	3		10	20	8	17	11	10	9	10	8	10	7
14			5	9		9	12	8	9	10	10	7	21	9	12	9
15			4	10		8	11	8	10	13	3	5	21	10	13	10
16			5	11		7	5	7	8	10	7	4	20	10	8	9
17			4	8		7	4	5	3	8	10	6	12	5	8	8
18			5	6		3	8	3	3	7	5	4	10	8	9	7
19			6	4		3	7	4	7	5	9	4	12	7	8	8
20			5	6		4	2	4	7	7	5	6	9	7	8	3
21			4	5		5	7	2	3	6	4	7	10	6	8	6
22			4	5		10	4	3	5	4	2	6	8	4	7	5
23			3	1		7	2	2	2	4	2	5	8	3	8	2
24			3	2		8	2	2	2	4	2	2	8	2	4	2
25			5	2		4	2	3	2	3	2	2	6	2	3	2
26						3										
27																
28																
Bend 29																
30																

and the metal of the tube. Thickness of tube wall and composition of deposit have no effect on indication.

If the indicator reads 0.003 or 0.004 in., that indicates scale is forming and should be watched. An indication of 0.010 to 0.015 indicates trouble may be expected. In addition, when going over a rough surface, such as is found in areas of pitting and corrosion, the indicator hand will flicker and read abnormally high showing a trouble spot. Abnormal local scale deposits may precede pitting and corrosion. Where areas of scale or pitting are found, sections of tube may be replaced. Type of scale, pressure and temperature, heat transfer and such factors affect interpretation of the indications.

One utility using the indicator reports that it goes over an entire boiler carefully if the indicator shows any deposits and cuts out and replaces sections of tubes. Particularly after acid cleaning and washing tubes with high-pressure water, the indicator is run through the tubes to check them. Its indications give a very good criterion of when it is necessary to acid clean a boiler. This utility states that it has never unnecessarily cut out any tubes in which bad spots were indicated by the instrument, and that it finds the device invaluable in making repairs. It states that savings in maintenance and outage time made by this instrument pay for its cost many times over.

* * *

The production of stainless steel has increased from 42,000 tons in 1929 to well over 600,000 tons in 1948.

BASIC POWER PLANT FIGURING—5

A Review for Old-Timers — A Must for Young-Timers

By WILLIAM H. ENGELMAN

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STEAM FLASH—EXPLANATIONS AND PRACTICAL EXAMPLE

WHEN WATER is discharged into the atmosphere through a relief valve, trap or by some other means at a higher temperature than 212 F, a certain percentage of this water flashes into steam. This phenomenon is often mistaken for live steam discharging into the air, especially in a steam trap installation, therefore an explanation of steam flash is required. The following is based on the explanation given by Crane Co.

Steam at atmospheric pressure contains 1,150.4 Btu per lb.
while the heat in the liquid is 180.1 Btu per lb.

The difference between these values is 970.3 Btu per lb.

which is the heat of evaporation at atmospheric pressure and 212 F. The temperature of steam and water are exactly the same, which is true for saturated steam where the water is in direct contact with the steam.

Suppose that steam at 250 psia is condensing and the condensation is discharging through a trap into the atmosphere. From Keenan and Keyes steam tables the temperature of the steam and condensation is 400.95 F and the heat content of the water is 376 Btu at this temperature. In order to determine the quantity of water which will be converted into steam, subtract the heat content of water at 212 F and 14.7 psia or 180.1 Btu from the Btu of the water at the discharge pressure, or 376 Btu. Divide the obtained value by the heat of evaporation or 970.3 Btu. The result is the percentage of each pound of water which is converted into steam at atmospheric pressure.

The equation is thus:

$$X = \frac{h_f - 180.1}{970.3} = \frac{376 - 180.1}{970.3} = 0.202 \text{ or } 20.2\%$$

If the pounds of water discharged in a certain time is known, the amount of steam formed may be determined by multiplying this value by the flash factor thus found. For instance, if 100 lb of water was discharged in one hour, the quantity of water converted into steam is:

$$100 \times 0.202 \text{ is } 20.2 \text{ lb}$$

If the discharge line is long, or if the trap or valve discharges into a closed receiver, the flashing of water into steam may cause a back pressure which may be detrimental to their operation. This problem should be investigated thoroughly before the size of trap or relief valve is specified.

* * *

Example: — 10,000 lb of water at 265 psia and 306.11 F are suddenly released to the atmosphere. Find the pounds flashing to steam.

Let: s = pounds water flashed to steam; $(10{,}000 - s)$ = remaining water.

Heat in liquid is: $10{,}000 \times 381.6 = 3{,}816{,}000$ Btu

$(10{,}000 - s)\ 180.1 + 1150.4\ s = 3{,}816{,}000$

$1{,}801{,}000 - 180.1\ s + 1150.4\ s = 3{,}816{,}000$

$-180.1\ s + 1150.4\ s = 3{,}816{,}000 - 1{,}801{,}000 = 2{,}015{,}000$

or $970.3\ s = 2{,}015{,}000$, and $s = 2{,}015{,}000 \div 970.3 = 2{,}077$ lb of water flashing to steam

$10{,}000 - 2{,}077 = 7{,}923$ lb remaining water.

CHARACTERISTICS OF UNUSUAL WASTE FUELS

By WILLIAM O. ORDINANZ

Mechanical Engineer, Brasov, Rumania

FROM TIME TO TIME articles have been published describing the burning of various kinds of waste fuels under power boilers. Furnace designs for such waste fuels also have been described.

It may be of interest, therefore, to present data on several types of waste fuel which have been used in different localities where they are available. Usually, these are regarded as inferior fuels but since they have to be burned it becomes necessary to know something of their properties and characteristics. Very little, for example is available in the literature on fuels such as, straw, bark, husks of rice and oil seed. The use of these fuels, of course, is limited to the districts where they are produced and to the seasons of their existence, but in small plants, when burned properly, they can compete favorably with wood, peat and even low grade coal.

The characteristics of several of these waste fuels are given in the accompanying tabulation.

Table I. Properties of waste fuels.

Kind of fuel	Average composition and calorific value of crude fuel								Average composition and calorific value of combustible matter						Volatile content of combustible matter
	C %	H %	O %	N %	S %	Ash %	Moisture %	Net calorific value BTU per lb.	C %	H %	O %	N %	S %	Gross calorific value BTU per lb.	%
Wood waste (shavings, trimmings, etc.)	42,1	5,o	34,8	o,5	—	2,6	15,o	6360							
	34,6	4,2	28,7	o,4	—	2,1	30,o	5060	51,o	6,1	42,3	o,6	—	8750	70-85
	27,2	3,3	22,5	o,3	—	1,7	45 o	3760							
Tan bark	16,3	1,9	13,o	o,3	o,1	2,4	66,o	1875	51,7	5,9	41,3	o,9	o,2	8700	76
Sunflower stalks	48,o	5,6	39,5	o,9	o,1	1,9	4,o	6740	51,o	5,9	42,o	1,o	o,1	8740	80
Flax stalks	43,9	5,3	36,o	o,9	o,1	2,8	11,o	6930	51,o	6,1	41,8	1,o	o,1	8800	83
Rice husks	35,9	4,4	30,6	o,5	o,1	18,5	10,o	5640	50,3	6,1	42,8	o,7	o,1	8600	80
Straw	43,3	5,3	36,2	o,9	o,1	4,2	10,o	6650	50,5	6,2	42,2	1,o	o,1	8530	

Tips for Operators on Backwashing Ion Exchangers

Backwashing keeps ion exchange resins clean . . . Temperature governs resin bed expansion and flow rate . . . How "bumping" frees resin particles of coatings, may increase capacity 25 per cent . . . Surface washers . . . If micro-organisms, like algae, reduce efficiency, chlorination is effective . . . For food and beverage plants, can't use chlorine but a sterilizing reagent is available

By **JOSEPH THOMPSON** and **FRANCIS X. McGARVEY**
The Resinous Products Div., Rohm & Haas Co.

EFFECTIVE BACKWASHING maintains ion exchange resin units at peak capacity by keeping the resin particles clean. To this end, the following tips are offered to help power plant engineers and others to whom water softening or deionization is a vital process.*

In backwashing, the rate of upflow of water through the exchange bed should be such that the bed expansion is at least 50 per cent. With this expansion, the particles are scrubbed; the bed freed of contaminants; and the resin particles are reclassified so that the larger particles are found at the bottom of the bed. Expansion of the resin bed during backwash eliminates channeling or packing which may cause reductions in operating efficiency.

Effect of Temperature

Temperature of the backwash water is an important factor governing bed expansion which is overlooked most frequently. Figure 1 shows how bed expansion depends on temperature and flow rate for the cation exchanger, Amberlite IR-100. This chart illustrates the problem of the operator of an installation where a pump rated to deliver 5 gal per sq ft per min at 60 F was used at 125 F. The bed expansion of 18 per cent that resulted was insufficient and could be raised to the desired 50 per cent only by installing a new pump that could deliver the necessary 9 gal per sq ft per min at the operating temperature.

Backwash characteristics of the anion exchanger, Amberlite IR-4B, are pictured in Figure 2. Since some applications may require backwashing of the resin bed before it is completely exhausted, Fig. 3 presents the data for the regenerated form of the resin. Because of the lower density and smaller size of this form, much lower flow rates are needed for the desired expansion.

FIGURE-1

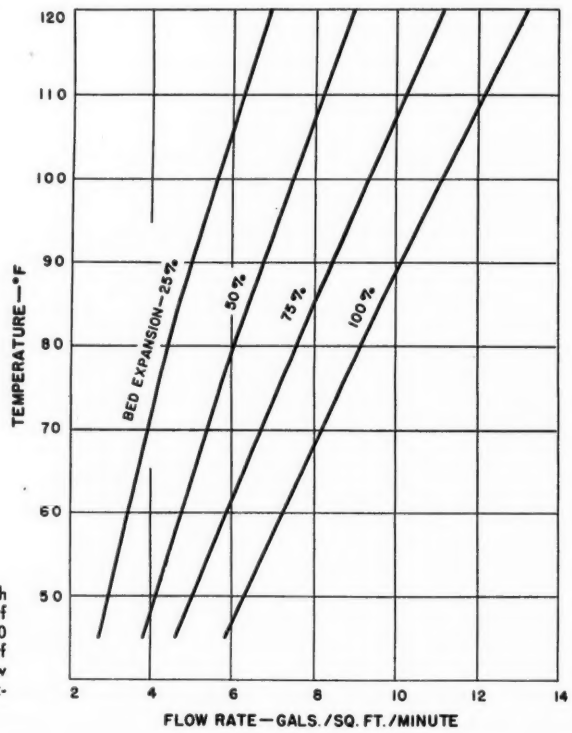


Fig. 1. Backwash characteristics of Amberlite IR-100 showing relations of temperature, flow rate and bed expansion

Bumping

When the influent to the ion exchanger contains solids that coat the resin particles, and backwashing does not scrub the particles clean, "bumping" can be used to combat a progressive reduction in exchange capacity. This procedure consists of draining the exchange unit and allowing the backwash water to surge violently through the bed, thereby scrubbing the particles vigorously and freeing them of coating. An increase in capacity of about 25 per cent has been reported by operators in one plant who used this procedure in the middle and at the end of the exhaustion cycle.

With influents to the exchanger containing a high proportion of suspended solids, it is becoming rather common practice to use surface washers of the type employed in filter units. In one large Midwestern plant, the increase in capacity resulting from the installation of surface washers in one exchange system has prompted their specification in all other exchange systems.

Control of Micro-organisms

Contamination of exchange units by micro-organisms presents a more difficult problem. The efficiency of Amberlite IR-100 in a Southern installation was markedly reduced by algae in the feedwater. The organism formed a crust on the surface of the resin bed, which resulted in excessively high head losses. Cracking of this crust led to channeling, premature break-through of ions, and a reduction in the operating cycle. Chlorinization of the influent in concentrations of about 2 ppm effected lower head losses, longer cycles, and less frequent backwashing, without altering the chemical or physical properties of the exchanger.

In another case, difficulty was encountered with iron-consuming micro-organisms, probably intro-

* Extracted from overall treatise on Practical Aspects of Deionization, by Thompson and McGarvey; the *Eighth Annual Water Conference*, Engineers Soc. of Western Penna.

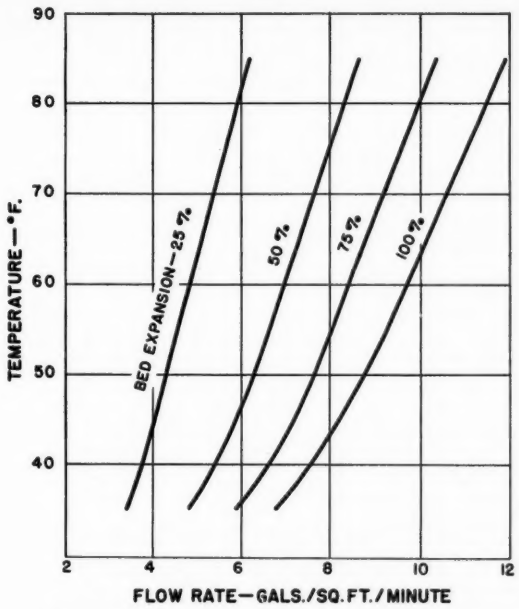


Fig. 2. Backwash characteristics of Amberlite IR-4B, exhausted form

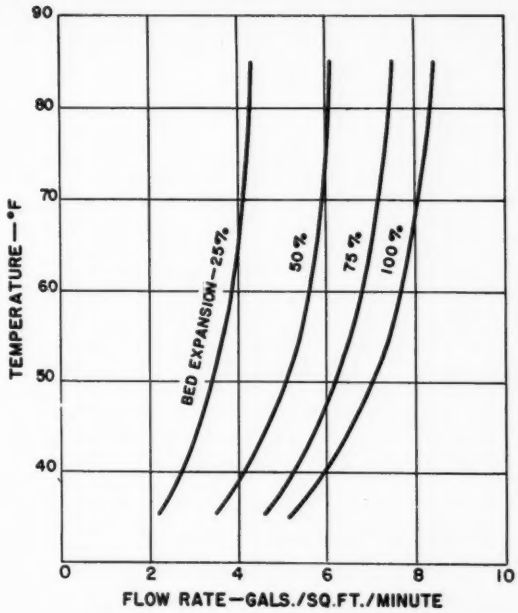


Fig. 3. Backwash characteristics of Amberlite IR-4B regenerated form

duced in the backwash water. The addition of 5 ppm of chlorine in the backwash water eliminated the objectionably-high head losses caused by clogging of the under-drainage system.

Since organic-type exchangers absorb high concentrations of chlorine, it cannot be used to sterilize the exchange beds of the bottling, pharmaceutical, beverage, and food industries. This need, however, has been filled by the development, by a sterilizing reagent manufacturer, of a compound that gives every indication of killing bacteria without affecting the resin-type cation and anion exchangers.

11th Midwest Power Conference

Feedwater Treatment; Small Power Plant Design, Operation and Maintenance; Steam Contamination; Cyclone Burners; High-Pressure High-Temperature Boiler and Turbine Developments — Discussed by over 2,000 engineers from all parts of the country in highly-successful all-power meeting, Hotel Sherman, Chicago, April 18-20, 1949

By CHESTER R. EARLE, Managing Editor, POWER GENERATION

A FEATURE of the 11th Annual Midwest Power Conference, not listed among the technical papers or discussions, was the sight of Professor Stanton E. Winston, for 10 years director and "spark plug" of the Conference, seated relaxed in a big arm chair on the mezzanine of the Hotel Sherman, puffing contentedly on a well-seasoned briar pipe, greeting the visiting engineers by the dozen, and having no further direct responsibility for the conduct of the proceedings. Every visitor said he had never expected to see Professor Winston sit down and relax at the meeting.

This year, because of pressure of his duties as Dean of the evening division of Illinois Institute of Technology, Professor Winston transferred the duties of running the Conference to the very capable shoulders of R. A. Budenholzer, Professor of Mechanical Engineering at I.I.T. In recognition of Winston's work in organizing the Conference in 1938 and developing it into the outstanding event it is today in the lives of all power engineers, the Conference presented him with a watch, at the All Engineers' Dinner on April 19.

At the same dinner, Lt. Gen. Raymond A. Wheeler, Technical Advisor, International Bank for Reconstruction and Development and former Chief of Engineers, U.S.A., was presented with a scroll expressing the appreciation of engineers for his services both to industry and the country. General Wheeler delivered an address on Engineers—Builders of Progress.

Feedwater Treatment

Outstanding in the Meeting was the great interest shown in the papers on feedwater treatment, steam contamination, and industrial power plant problems.

Feedwater Treatment With 100 Per Cent Make Up For The 1500 psig Boilers at Whiting, Ind., was detailed by Glen Hull, General Foreman, Utilities Division, Standard Oil Company of Indiana, Whiting, Ind. As completely described in POWER GENERATION, April, May and August, 1948, the feedwater treatment system installed for 3 — 1500 psig boilers of the dual circulation type is a hot lime-soda-phosphate treating plant; it is believed to be the first time water treated in this manner has been used to feed 1500-psi boilers with 100 per cent make-up. The feedwater treating system is designed to produce feedwater of extremely low silica content for these boilers from Lake Michigan water and the speaker showed how this is held to values of the order of 1.8 ppm in the primary boiler section from which steam is delivered.

Performance of another hot lime-soda-hot phosphate water treating system preparing water for the new central boiler station of The Steel Co. of Canada, Ltd., at Hamilton, Ontario, was given by A. C. Elliott, Assistant Combustion Engineer of that company. The water treated here is all from Burlington Bay and

is contaminated by sewage and industrial wastes, acids, alkalies, oils, flue dust and surface silts. After continuous service at periods of 6 to 8½ months, internal surfaces of the boilers were found to be in excellent condition.

The mechanism of silica carryover in boiler steam and of turbine blade deposits was explained by Frederick G. Straub, Research Professor, Chemical Engineering, University of Illinois.

In the various units of American Gas and Electric Co. System, said W. L. Webb, turbine deposits have been reduced by lowering silicate concentration in boiler waters but are still troublesome in some plants. Under load, soluble deposits move from one stage group to another with wide changes in steam temperature. At 1800 psi and below, over 750,000 kw of turbine capacity is affected and capabilities and efficiencies on individual units have been reduced as much as 12 per cent and 8½ per cent, respectively.

J. D. Yoder of The Permutit Co. reviewed the methods of removing silicate from boiler feedwater by the sludge blanket hot process softener and exchange methods. By hot process treatment, the silicate can be reduced to a lower figure than by ferric hydroxide but not so low as by demineralization; and chemical costs of silicate removal by this method are less than by either of the other two methods.

Steam Formation and Carryover

L. O. Gunderson and C. M. Bodach of Dearborn Chemical Co. showed motion pictures of bubble formation and related phenomena, illustrating some of the important questions in origin of bubbles, rate of growth and coalescence, influence of the nature of the heating surface, and the action of organic foam inhibitors.

To identify causes of carryover, as discussed by P. B. Place, Combustion Engineering-Superheater, Inc., each type and source of carryover has characteristic reactions to changes in water level, rating, boiler water concentration and other factors. Further data on diagnosing carryover problems were presented by J. A. Holmes of National Aluminate Corporation.

Problems in treatment of cooling water in industrial plants were covered by L. Drew Betz and John J. Maguire of W. H. & L. D. Betz and will be given in detail in a later issue.

E. C. Hosbach of the Texas Co., Lockport, Illinois, showed how water from the Chicago Sanitary Drainage Canal, incrusting and corroding the water service lines and coolers, was treated with a polyphosphate coupled with an inorganic synergist, showed good results and corresponding decrease in power costs with improvement in heat transfer rates.

Water treatment for high pressure plants of Dow Chemical Co. was discussed by Louis Wirth, Jr., of that company. After showing the development of a hot process softener for boilers using condensate, he described a new water treatment plant for demineralizing water for new 1250 psi boilers as outlined in Power Generation, March 1949.

Water distillation from evaporators with capacities as high as 100,000 gal per day or 4200 gph by compression distillation was discussed in detail by E. T. Erickson of Erickson Chemical Co. (See *Power Plant Engineering*, Feb. 1946.)

Electrical Developments

Costs of supplying incremental losses in electrical systems like the cost of supplying any incremental load are made up of—(a) Cost of generating or purchasing the incremental kilowatthours, and (b) the cost of capital investment required to supply incremental peak kilowatts and these were explained by Paul H. Jeynes of Public Service Electric and Gas Co., Newark, New Jersey.

Comparison of advantages and cost of nine basic industrial electric distribution systems were discussed by Harry B. Thacker of Westinghouse Electric Corp., while E. Herzog described the resonant grounding of distribution systems at Wright-Patterson Air Force Base.

Boilers

Successive purchases of boilers by a certain utility since 1920 to show the development of the water-cooled furnace and other details as well as methods for controlling superheat and reheat temperatures were detailed by E. M. Powell of Combustion Engineering Superheater.

Because of studies now being carried out up to 1600 F, said Frank X. Gilg of Babcock & Wilcox, it is reasonable to expect to go higher than the present 1100 F limit for steam temperature. He discussed also the circulation of gas from economizer to furnace. He said 50 cyclone burners had been purchased and 5 are in operation. Pressure operation of furnaces through the omission of induced-draft fans is becoming a trend, he stated, as in the new Dow No. 13 unit (March issue).

In discussing this paper, H. W. Wallace of Foster-Wheeler showed use of multiple furnaces with differential firing for control of total steam temperature and the use of the dual circulation boiler, as at Whiting, to reduce carryover and blowdown losses.

Gas Turbines

W. B. Tucker of Allis-Chalmers Manufacturing Co. reviewed in detail the design of a locomotive gas turbine now being built by his company primarily for the coal-burning gas turbine locomotive.

Problems involved in the design of such a locomotive were reviewed in detail by C. K. Steins of the Pennsylvania Railroad. He reviewed the developments up to date, discussed the present work with the silicon carbide combustor, the influence of fineness of coal pulverization, and problems in cleaning the combustion gas before it enters the turbine.

Considerable attention was given to the dual-fuel engine and gas Diesel. Ralph L. Boyer of the Cooper-Bessemer Corp. explained the operation of the engine, which burns gaseous fuels and/or fuel oil, in either case being full Diesels.

George Steven of Worthington Pump and Machinery Corp. also discussed this engine, as made by his company, giving many of the details of cylinder head, governor linkage and fuel control mechanism and discussed automatic switching from gas to oil and showed data on economy of operation.

Small Plant Problems

Parker A. Moe, Consulting Engineer, reviewed the factors to be considered in design of industrial power plants. He pointed out the factors influencing steam pressure and temperature in industrial plants; showed how an industrial plant, with a good cycle, will have an overall thermal efficiency as high as 75 or 80 per cent; described the various cycles and types of turbines used; and showed tabulation of the additional coal required for power generation at different steam conditions compared with supplying live steam to process without power generation.

What a small plant can do about fly ash was discussed by Carl E. Miller of Batelle Memorial Institute. He pointed out the types of small plants referred to; discussed typical dust-emission regulations.

Taking what data are available on fly ash emission from multiple retort under feed stokers and spreader stokers, the author concluded that the safest plan for spreader stokers is to install a fly ash collector of high efficiency even though it is a high-draft loss unit and probably requires induced-draft fan equipment. He pointed out the need for a lower cost collector unit for small installations. Further details of this paper will be given in a future issue.

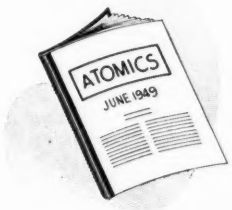
National Problems

E. R. de Luccia, Federal Power Commission, pointed out the reasons why we have low reserve capacity and predicted that by 1960 we would have to have a total of 100,000,000 kilowatts of utility capacity with 15 per cent reserve, meaning that 61,000,000 kilowatts must be added, not including replacement of 10,000,000 kilowatts now obsolete.

Edward Falck, National Security Resources Board, reviewed the work of that organization and made an appeal for public and private power proponents to get together in the interest of national security.

Announcing

An Expanded ATOMICS Service



IN SEPTEMBER, 1945, less than a month after the atomic bombs were dropped on Hiroshima and Nagasaki, we published the first full-length article on atomic energy. While the actual announcement of the success of the atomic bomb was as much of a surprise to us as it was to everybody else, we were, nevertheless, very much aware of its implications—some of our editors had been interested in the subject of nuclear energy for a great many years.

Recognizing the tremendous importance of atomic energy to the human race, we immediately laid plans for covering the subject for the benefit of our readers and in October 1945 we inaugurated the "ATOMICS" section in *Power Plant Engineering*. That was over 3½ years ago. Since that time, the ATOMICS section has appeared regularly in every issue and interest in it has grown month by month, year by year. Without exception, more articles on the technical and engineering aspects of atomic energy have appeared in the ATOMICS section of POWER GENERATION than have appeared anywhere else. ATOMICS was the first regular publication of its kind in the entire field of technical publishing. It antedates all other regular publications dealing with nuclear reactions.

More than 50 articles of major importance on atomic energy and its applications have appeared since the section was launched. These articles have all been of a practical, understandable character, written for engineers, not nuclear physicists. Material of this type has appeared nowhere else. It has constantly been the aim of the editors to translate the complex, highly technical material issuing from the laboratories into language that the average engineer can understand.

As a consequence of this policy, the articles that have appeared in ATOMICS have gained unusual acceptance; the demand for reprints and back numbers of the magazine has been so heavy that stocks have been exhausted within a month or two after publication. A considerable portion of this demand has been from industrial laboratories and from the plants operated under the U. S. Atomic Energy Commission.

Because of this steadily growing interest in atomics and the important developments that the AEC is planning, we have decided to expand ATOMICS and to publish it as a separate publication. Beginning with the June issue it will appear as a new journal.

In its expanded form it will be of interest to all who are in any way concerned with or interested in the technical and engineering aspects of nuclear power as well as to those interested in industrial, biological, and medical applications of nuclear reactions. Its down-to-earth character will not change, however. There will be articles of timely interest to those concerned with industrial process control; atomic power development will continue to receive major attention; there will be educational articles giving basic information to those who need to start from the ground up. The new ATOMICS will contain an Atomic News Section, presenting timely information regarding new developments. Also, it will contain a Book section listing books and other publications on atomic energy.

Beginning with the June issue, we will present a complete course in Nuclear Power Engineering. This will begin at the beginning—with a clear-cut consideration of the structure of matter and following through, each month, with chapters on methods in nuclear physics, neutron physics, nuclear chain reactions and finally, the design and construction of nuclear reactors.

In short the new ATOMICS will provide complete technical and news service to all who are interested in atomic energy in its more practical aspects.

If you are interested in seeing the first issue of this new publication, just fill in the coupon at the bottom of this page and we will gladly send it to you *free*.

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Twin 100,000-kw Turbine Generator Se

The two 100,000 kw turbine generators at Station "P" of the Pacific Gas & Electric Co. at Hunter's Point on San Francisco Bay are the largest units installed west of the Mississippi. Installed in record times of 58 and 52 working days respectively

TWO IDENTICAL General Electric 100,000 kw turbine-generator sets, the largest units west of the Mississippi, are now in operation at the Pacific Gas & Electric Company's Station "P." These units, shown in the accompanying photographs, are part of P. G. & E's expansion program adding 1½ million kilowatts to its system, raising the total generating capacity of the system to around three million kilowatts.

Originally built as a 35,000 kw station, a new addition costing $30,000,000 and raising the capacity to 235,000 kw makes Station "P" the largest single power station on P. G. & E's network. Two 7500 kw house turbine-generator sets are installed as auxiliary power supply systems in case of system disturbances.

Located at Hunter's Point on San Francisco Bay, the enlarged plant is approximately 400 feet long and 200 feet wide. Four oil or gas-fired boilers generate nearly 2 million pounds of steam per hour. The plant requires over 230 million gallons of cooling water each day for the operation of the condensers.

Installed by a General Electric crew, the units were placed in operation in record time: the first in 58 working days and the second in 52 working days. As described on page 68 of the February issue a 74-wheel trailer was required to carry the armature of each of the generators from the railroad siding to the station. The armatures, which constituted the largest single piece of the installation, weigh more than 335,000 pounds.

The photographs on this and the opposite page show the two generators installed in the new addition to the station.

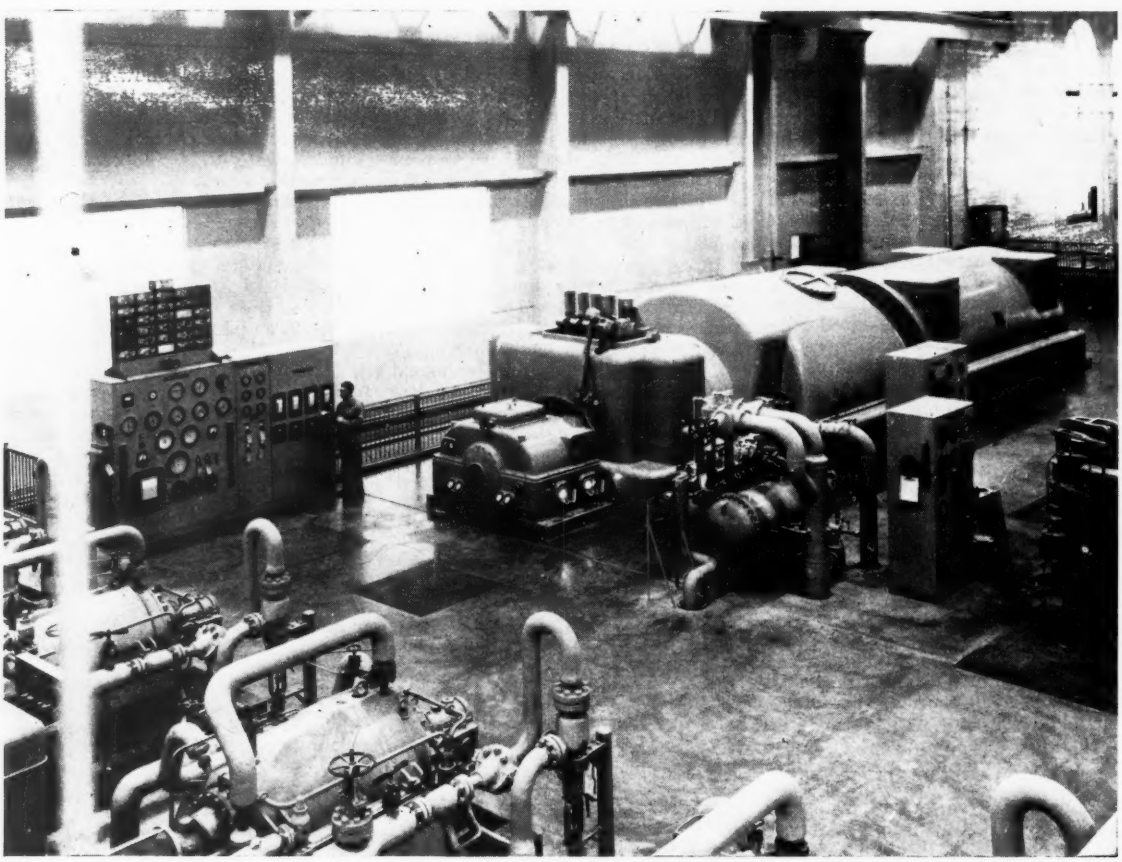


Fig. 1. Interior view of Station "P" showing one of the two 100,000-kw generating units installed in the station

tor Sets in Operation at P. G. & E.

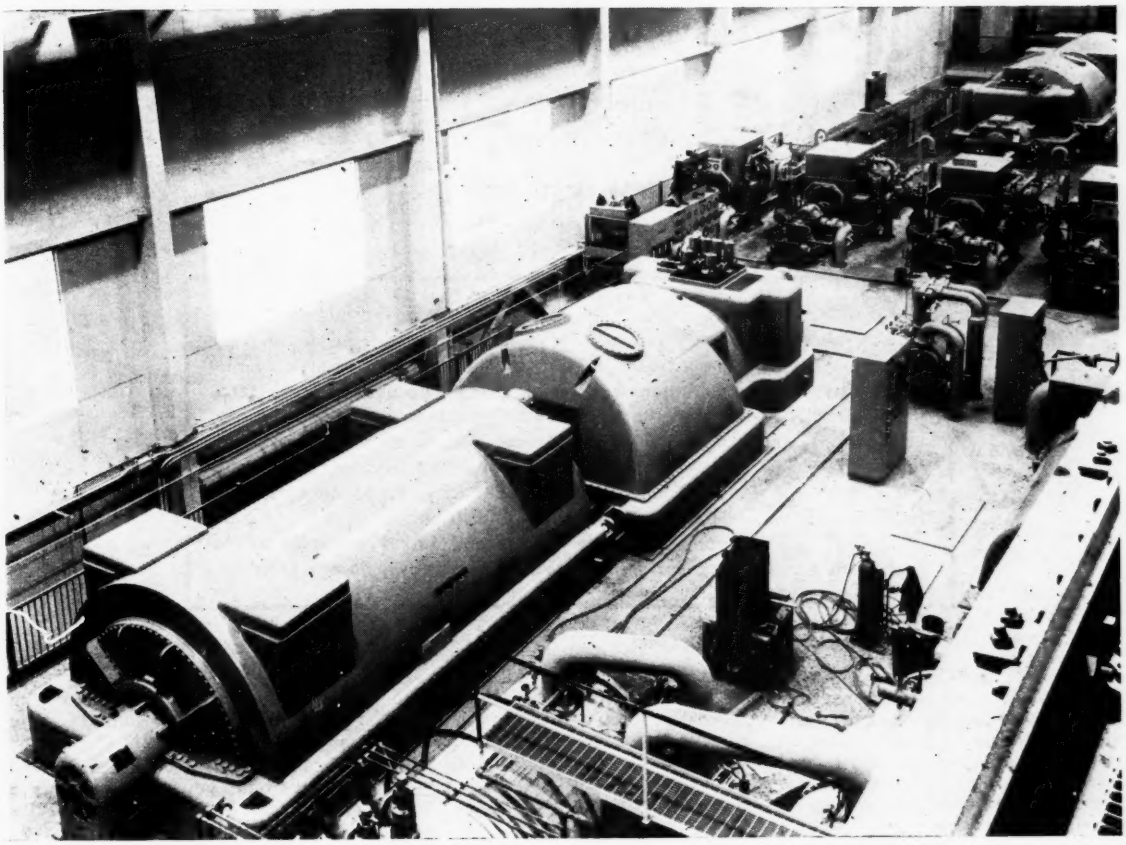


Fig. 2 (Above) A view from above showing both of the 100,000 kw units and auxiliary equipment

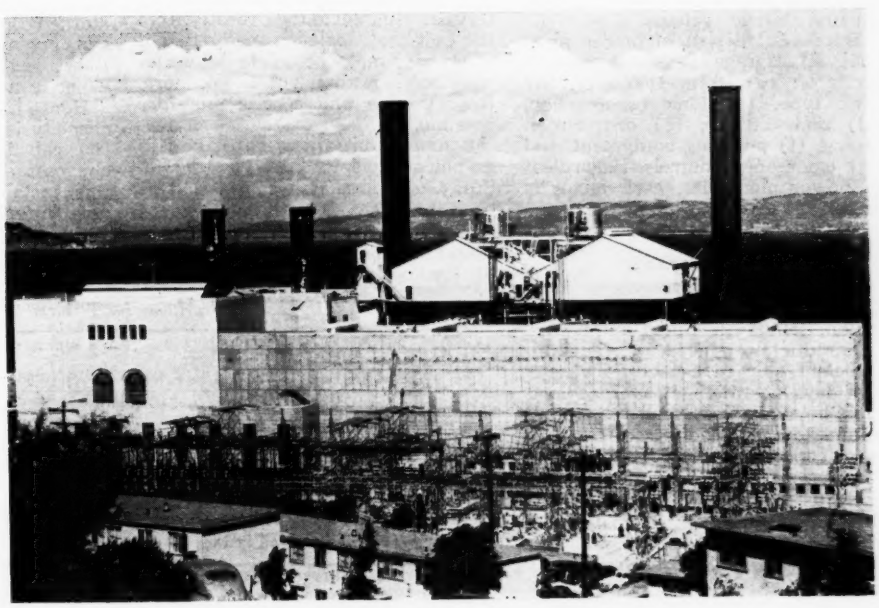


Fig. 3 (Right) This is an exterior view of Station "P" of the Pacific Gas & Electric Co., in which the 100,000 kw generating units are installed. This station was originally built as a 35,000 kw capacity station. The installation of the two new units brings the capacity up to 235,000 kw

A FUEL OIL STORAGE FEATURE

PLANNING POWER PLANT FUEL OIL STORAGE SYSTEMS

By TYLER G. HICKS
Hicks Associates, New York, N. Y.

Like any other element in the design of a power plant, the fuel oil storage system, if oil is used as fuel, requires careful planning and design if it is to be effective. It must not only provide an adequate reserve of fuel under all forseeable conditions but it must present no unusual fire hazard. In this article, Mr. Hicks, who as a consulting power plant engineer has had considerable experience in the design of fuel oil storage systems, tells exactly how such systems should be designed. As he points out, this requires a study of such factors as capacity, types of tanks and tank construction, selection of tank fittings, distribution piping, pumping equipment and control equipment. Charts and tables are included to enable any operator or plant designer to work out his own storage problems

WELL-PLANNED power plant fuel oil storage systems provide adequate fuel supply with minimum fire hazards. Poorly planned systems may cause costly fuel shortages and present fire hazards which seriously endanger plant personnel, structures, and manufactured goods. The difference between good and bad planning, layout, and design can readily be understood by study of those factors which affect all fuel storage systems.

Successful design of power plant fuel oil storage systems requires study of: (a) storage capacity, (b) tank type, (c) tank construction, (d) tank fittings, (e) distribution piping, (f) pumping equipment, and (g) emergency controls. Regardless of power plant size, each factor is important in system design and operation.

Storage Capacity

Storage capacity required is a function of plant capacity, plant location, delivery facilities, and nature of product produced. In general, sufficient storage capacity for several days operation at average load must be available. Besides this minimum storage capacity a certain reserve capacity is a necessity for continuous operation. This reserve capacity is needed to care for delivery delays resulting from storms, floods, strikes, production shortages, and traffic tie-ups.

For plants located in metropolitan areas where shipment delays are seldom protracted or in areas where several supply sources are available, reserve capacity can be comparatively small. Isolated plants and plants dependent upon a single source of supply must have comparatively large reserve capacities. In addition there is often an economic advantage in providing sufficient reserve to permit complete unloading of a tank truck or car at stated intervals. This advantage results from the fact that dealers usually find it cheaper to make complete deliveries with one stop than with two or more. Reduction in unit cost is therefore possible.

Storage capacity required is graphically represented in Fig. 2. Study of this sketch shows that at least three factors must be considered when selecting tank size. A horizontal circular tank was selected for illustration purposes, but the requirements are valid for any type tank. Influence of each factor can readily be seen by solution of a typical tank sizing problem.

Problem 1: A 4000 kw industrial plant turbine generator set has a guaranteed heat rate of 15,000 Btu per kwh at full load. Boiler efficiency when burning Bunker C fuel oil is 85 per cent. Average daily 8-hr load is estimated to be 60 per cent of installed capacity. Seven days storage and three days reserve capacity are required. Railroad delivery is available. Determine tank capacity needed.

Hence a tank of at least 26,690 gal. capacity is required. A standard 30,000 gal. tank would probably be cheapest and most satisfactory for this installation. Maximum allowable interval between deliveries would be ten days. Under normal conditions delivery every seven days would maintain required reserve.

Calculations for Problem 1

(1) Fuel consumption * = $\frac{(4{,}000\text{ kw})(15{,}000\text{ Btu/kw hr})(8\text{ hr/day})(0.60)}{152{,}000\text{ Btu/gal}\ (0.85)}$		= 2230 gal/day
(2) Average load storage capacity	= 7(2230)	= 15,610 gal.
(3) Reserve capacity	= 3(2230)	= 6,690 gal.
(4) Normal capacity		= 22,300 gal.
(5) Tank car delivery (2 cars @ 10,000 gal ea.)		= 20,000 gal.
(6) Maximum oil in tank = Line 3 + Line 5		= 26,690 gal.

* Auxiliaries' fuel consumption neglected. For extreme accuracy use fuel consumption determined from heat balance calculation.

Fig. 1. Neat installation of vertical above-ground fuel oil storage tanks. Earthen dikes around the tanks prevent the spread of fires, and the roadway in the foreground permits easy access by fire-fighting equipment

Where process and heating loads are supplied steam by oil fired boilers, tank capacity is determined by similar computations. Since maximum fuel consumption occurs during winter months, tank size is usually based on coldest weather expected. Usually it will be found that winter and summer delivery schedules will be different because daily consumption varies during the two seasons. Such delivery variations should be rigidly specified in dealer contracts.

Problem 2: An industrial plant located in the Chicago area will use 2000 gal per day of 140,000 Btu per gal oil for process steam generation. Plant heating system will have 20,000 sq ft of radiation. Determine fuel tank size for seven days storage and three days reserve capacity.

Basing the solution on the month of January, which for the Chicago area has an average of about 1260 degree-days, fuel consumption from Fig. 3 is about 23,500 gal. Outdoor design temperature for Chicago is —10 F. Hence, applying the temperature correction factor, consumption = (23,500) (0.875) = 20,600 gal.

For seven days storage, $\frac{7}{31}$ (20,600) = 4650 gal capacity is required. With three days reserve, storage capacity for heating is 6650 gal. Total storage capacity required for process and heating steam requirements is 26,500 gal. A 30,000 gal storage capacity would appear satisfactory.

Type of tank used is dependent on installation space available and capacity required. Best location is below ground outside power plant building. Where necessary or desirable, outdoor tanks can be located above ground. In heavily populated districts fuel storage tanks are usually located within the plant building, above or below ground. Laundry, hospital, hotel, and institutional power plants are frequently equipped with indoor tanks.

Local ordinances, insurance regulations, or the National Board of Fire Underwriters Standards govern allowable tank size and location. Table III summarizes the NBFU Regulations for underground storage tanks. Study of this table shows that as the distance from plant building increases, allowable capacity also increases. The 30,000 gal tank selected for the power plant in Problem 1 could be, according to NBFU rules, installed within the plant building provided that it were properly set.

Tops of underground tanks must be at least 2 ft below ground surface and lower than any connected piping. Leakage of oil through broken pipes or by syphoning is thereby

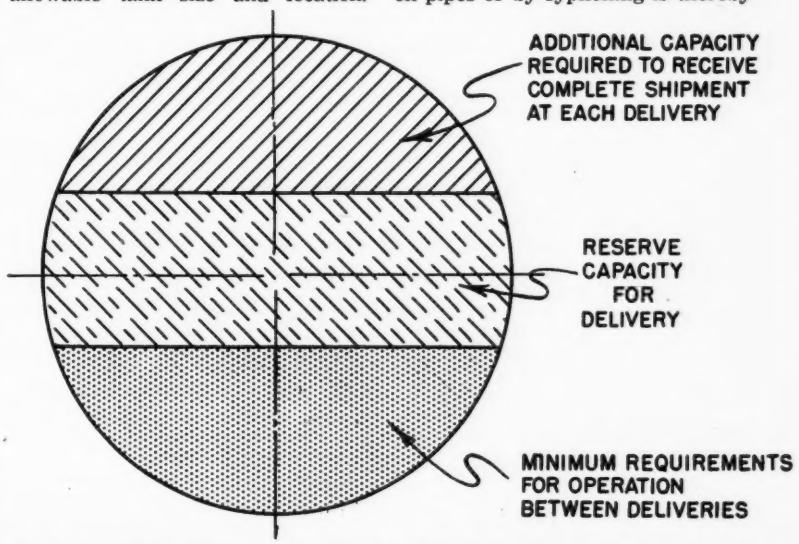


Fig. 2. Capacities which must be considered in fuel oil storage tank planning. Although a circular tank is shown the requirements are valid for any type tank

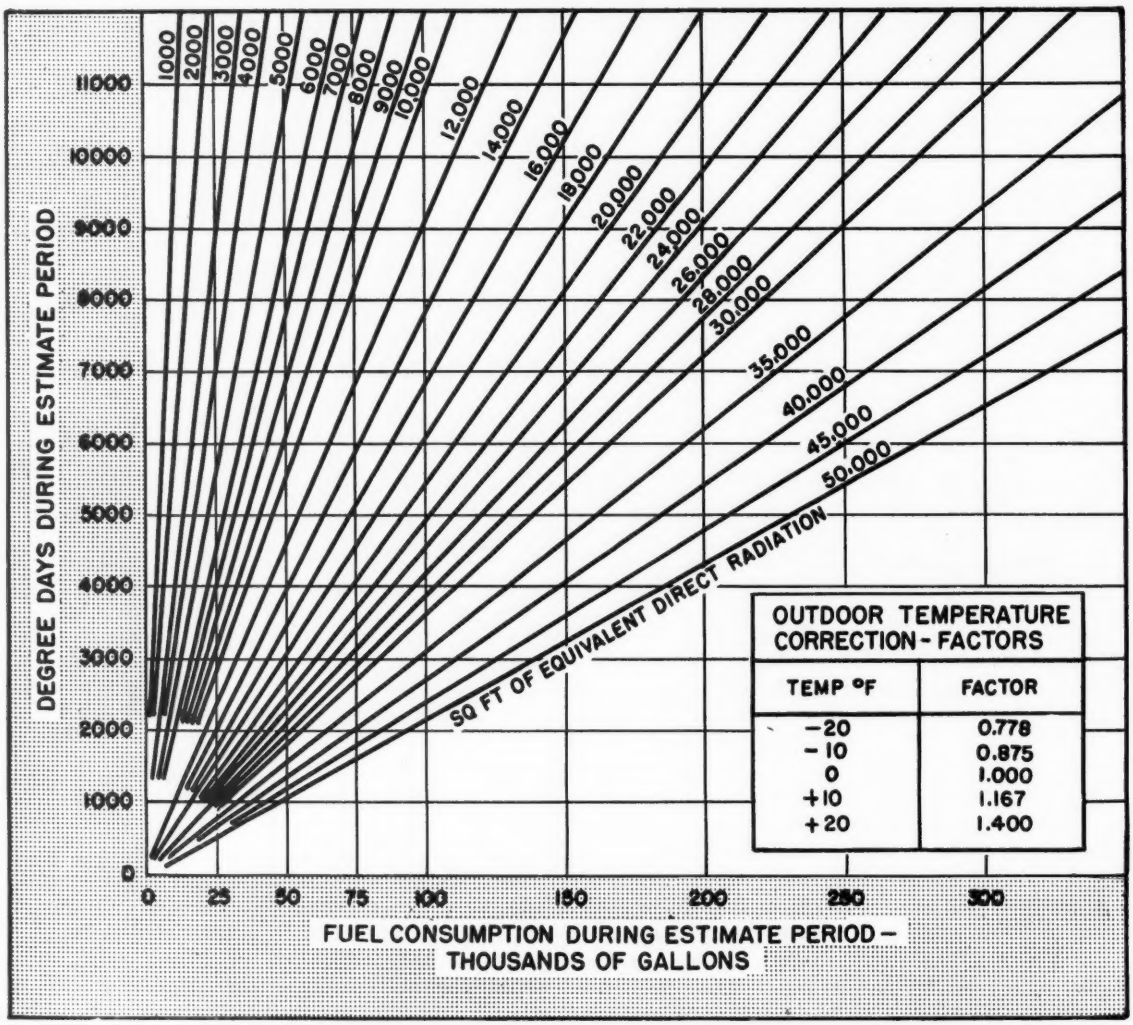


Figure 3. Heating fuel oil consumption estimating chart. Based on an outdoor temperature of 0 F, indoor temperature of 70 F, heating value of fuel oil 140,000 Btu per gal, and heating plant efficiency of 75 per cent. To use: determine number of degree days for estimate period from local weather data; enter lefthand ordinate with number of degree days and run across horizontally to sq ft of EDR installed, then vertically downward to fuel consumption in gallons. Example: 12,000 sq ft EDR, 5000 degree days, outdoor design temperature = + 10 F, fuel oil heating value = 145,000 Btu per gal. From chart, consumption = 55,000 gals if conditions corresponded to chart basis. Correcting for outdoor temperature and fuel heating value,

$$\text{Consumption} = (55{,}000)\ (1.167)\ \frac{140{,}000}{145{,}000} = 62{,}000 \text{ gal per 5000 degree days.}$$

prevented. When a 4-in. or greater thickness of reinforced concrete or equivalent material can be placed over tank only 12 in. of soil is required on top of tank. When buried under driveways, depth of soil above tank must be at least 3 ft. With a 6-in thick reinforced concrete driveway depth of soil need be only 2 ft. When tank cannot be completely buried it must be covered with at least 2 ft of soil on all sides. Slope at least 1½ to 1.

Floating of underground tanks is often encountered after installation. Ground water rising around the tank can exert enough force to cause rupture of soil fill and breakage of connected piping. Best remedy is proper loading of tank with reinforced concrete to prevent floating under all high water conditions which may be encountered. A simple and accurate method of determining required loading will be presented. Use of this method eliminates troublesome errors resulting from confusion of effective material weights in water and air.

Problem 3: A 15,000 gal power plant fuel oil tank is 8 ft in diameter, 40 ft long, and weighs about 14,500 lb empty. It will be buried under 2 ft of soil. Local records show that high water level has reached to within about 24 in. of ground surface. Determine loading required to prevent tank floating.

Since loading of some type is probably necessary, a concrete slab, Fig. 5, 10 ft wide, 42 ft long, and 6 in thick will be assumed. Then, pit area = 10 × 42 = 420 sq ft and pit volume = 420 × 10.5 in = 4410 cu ft. High water level in pit is 8.5 ft, or a volume of 3570 cu ft of water with a total weight of 62.4(3570) = 222,500 lb. To prevent floating of tank an equal downward force must be provided.

The 15,000 gal tank occupies 15,000/7.48 = 2000 cu ft of pit volume. Hence, 4410 − 2000 = 2410 cu ft of pit volume remain for loading material which must weigh at least 222,500 − tank weight, or 222,500 − 14,500 = 208,000 lb. If soil weighing 80 lb per cu ft were used for loading, 2410(80) = 192,800 lb force would be provided. This is 208,000 − 192,800 or 15,200 lb less than needed.

Assuming slab is made of stone concrete weighing 150 lb per cu ft, 15,200/(150 − 80) or about 218 cu ft of concrete is needed. The 10 ft by 42 ft by 6 in deep slab has a volume

of only 210 cu ft. To care for difference, 218 — 210 = 8 cu ft, the slab can readily be built up around tank sides as shown in Fig. 5. Instead of building up the lower slab, the required weight could be obtained by increasing upper slab depth until it rests on tank top.

Vertical above-ground fuel oil storage tanks are often used for power plants in moderately populated regions. Ground area required is usually greater than for underground tanks. Vertical above-ground tanks with capacities up to 80,000 bbl (3,360,000 gal) can be used provided they are of all steel gastight construction. Table II summarizes location requirements for various size tanks of the vertical type.

To prevent spread of fires, vertical above-ground tanks are enclosed in dikes. Separate dikes are required for tanks of over 100,000 gal capacity. Smaller tanks, 15,000 to 50,000 gal capacity, may be grouped with not more than 150,000 gal storage capacity in one dike. Dike capacity must be at least 1½ times storage capacity. Earthen or concrete dikes may be used. Dike should not slope more than 1½ to 1. When using concrete dikes be sure to provide for maintenance of them because cracks frequently develop and they must be sealed.

Horizontal above-ground tanks are governed by rules similar to those for vertical tanks. Location requirements are given in Table II. Concrete, brick, or protected steel supports must be used. Support bearing surfaces at least 12 in. wide and one-third tank circumference in length are used for diameters less than 72 in. For diameters greater than 72 in., bearing surface should be at least 18 in. wide and one-third circumference in length.

Table I

FUEL OIL PROPERTIES *

Grade	Commercial Name	Approx. Gravity Range Degrees Baume	Specific Gravity, Water — 1.0	Heat Content	
				Btu/gal	Btu/lb
No. 1 Oil	Light Furnace	38 — 40	0.82 — 0.83	136,000	19,600
No. 2 Oil	Medium Furnace	34 — 36	0.82 — 0.85	138,500	19,475
No. 3 Oil	Heavy Furnace	28 — 32	0.87 — 0.89	141,000	19,350
No. 4 Oil	Light Fuel	24 — 26	0.90 — 0.91	145,000	19,175
No. 5 Oil	Bunker B	18 — 22	0.92 — 0.95	148,500	19,000
No. 6 Oil	Bunker C	14 — 16	0.96 — 0.99	152,000	18,850

* National Bureau of Standards Commercial Standards

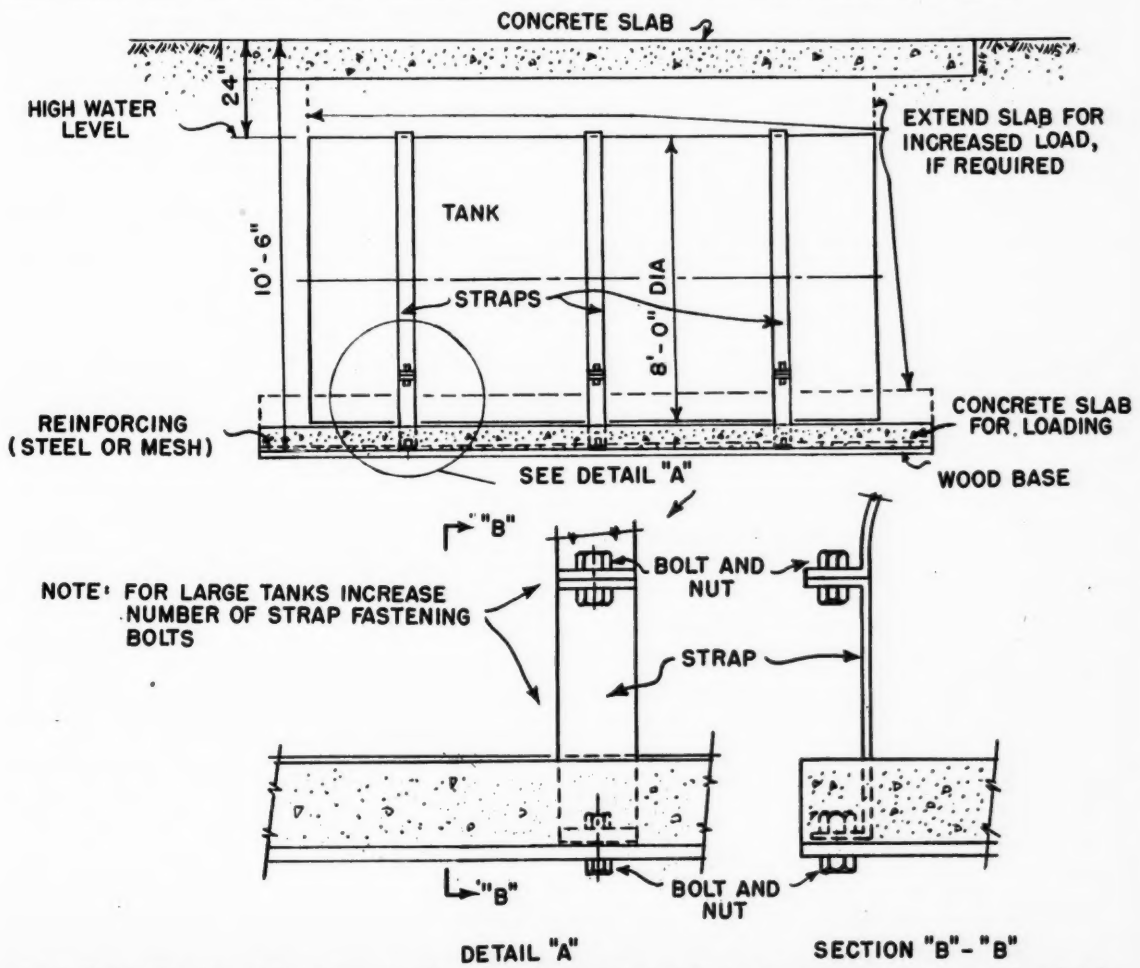


Fig. 4. Tank loading using reinforced concrete. This method of preventing tank floating is suitable for most types of buried tanks

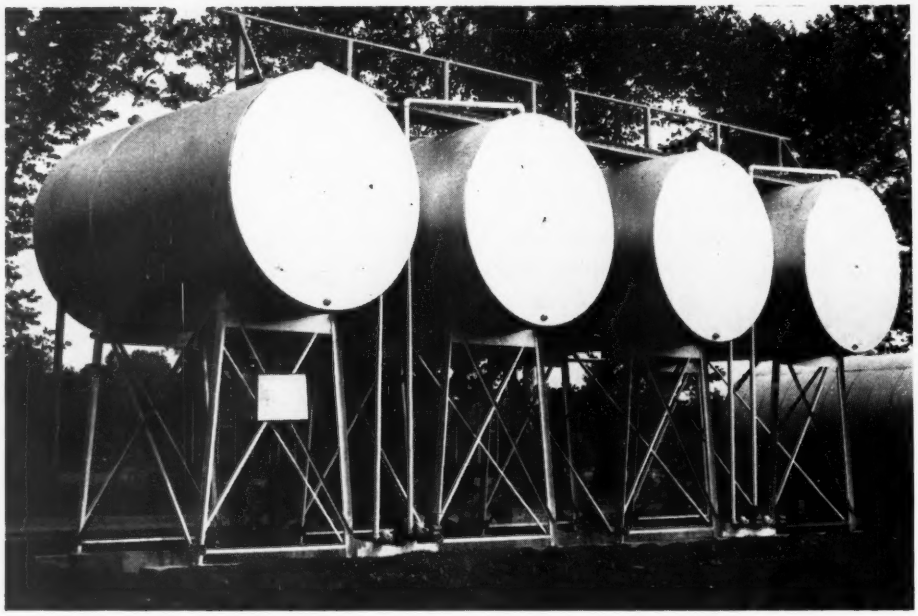


Fig. 5. Outdoor installation of horizontal above-ground tanks. Steel supports on concrete piers are used. Fill lines with gate and check valves are in the foreground

Table II

RECOMMENDED LOCATIONS OF VERTICAL ABOVE-GROUND TANKS			
Capacity of Tank, Gallons	Minimum Allowable Distance to Nearest Building, Feet	Capacity of Tank, Gallons	Minimum Allowable Distance to Nearest Building, Feet
Up to 750	5	Up to 64,000	50
Up to 1,100	10	Up to 80,000	60
Up to 3,000	20	Up to 128,000	75
Up to 21,000	25	Up to 200,000	85
Up to 31,000	30	Up to 266,000	100
Up to 45,000	40	Up to 400,000	150
MINIMUM ALLOWABLE DISTANCES BETWEEN TANKS IN GROUPS			
Capacity of Tank, Gallons	Minimum Distance To Nearest Tank, Feet	Capacity of Tank, Gallons	Minimum Distance To Nearest Tank, Feet
Up to 18,000	3	Up to 75,000	13
Up to 24,000	5	Up to 100,000	15
Up to 48,000	10	Up to 2,500,000	One tank diameter

RECOMMENDED LOCATIONS OF HORIZONTAL ABOVE-GROUND TANKS *		
Capacity of Tank, Gallons	Minimum Allowable Distance to Nearest Building, Feet	Dikes Required and Location
Up to 15,000	50	None
15,000-25,000	50	Wall 40 ft from main bldg.
25,000-100,000	75	Wall 50 ft from main bldg.
100,000	100	Wall 75 ft from main bldg.

* Associated Factory Mutual Fire Insurance Companies

Materials, construction methods, and tests are governed by various regulating bodies mentioned above. During power plant fuel storage system planning care must be taken to see that suitable materials are specified for tank construction. Tanks built according to underwriters regulations generally have lower insurance rates than non-ragulation tanks. Some communities prohibit tank installation unless it conforms to suitable construction rules. The importance of correct construction methods, materials, and tests can therefore be readily seen.

Table IV summarizes material requirements for various type tanks. Tanks of open hearth steel or wrought iron thinner than No. 7 must be galvanized. ASTM material specifications are used for practically all tanks built in this country. Riveted, welded, or brazed joints are used according to local requirements. All joints must be soldered, caulked, and otherwise made tight. Where necessary, braces for top, bottom, and sides should be specified. Usually two shop coats of red lead and one coat of hot asphalt are sufficient to prevent exterior corrosion of tank.

When tanks are to be buried in corrosive soils, special protective means must be used. In addition to the standard shop coats a reinforced concrete enclosure may have to be specified. This enclosure is built around and under the tank with a 6-in. space between tank sides and concrete wall. This space is filled with sand or well-tamped earth and 12 in. of sand placed on tank top.

Rectangular concrete or steel tanks are not often used for power plant fuel oil storage. Concrete tanks are

Table III

NBFU * REGULATIONS FOR OUTSIDE UNDERGROUND FUEL OIL STORAGE TANKS

Location: Top of tank must be lower than all floors, pits, cellars, or basements of building	Maximum Allowable Capacity, Gallons	
	Flashpoint less than 100 F	Flashpoint greater than 100 F
Within a radius of 50 ft	Unlimited	Unlimited
Within a radius of 40 ft	50,000	500,000
Within a radius of 30 ft	20,000	200,000
Within a radius of 25 ft	15,000	150,000
Within a radius of 20 ft	5,000	100,000
Within a radius of 10 ft	2,000	75,000

When within 10 ft of any building and tank top is above lowest floor, cellar, pit, or basement of the building, maximum tank capacity for oils with flashpoint less than 100 F is 550 gal; 50,000 gal for oils with flashpoint greater than 100 F.

* National Board of Fire Underwriters

costly and subject to cracking and leakage. Only heavy oils, Nos. 5 and 6, can be stored in concrete tanks. When they are used, the earth covering is omitted from concrete tanks.

At present there are no rules governing rectangular steel fuel oil storage tank construction. Most large tank manufactures have facilities for rectangular tank construction. They also are familiar with design problems and give worthwhile advice on construction methods, best dimensions, allowable loadings, and suitable stresses.

Every power plant fuel oil storage system design experience has shown that successful operation results when the factors discussed here are considered.

So far three factors, storage capacity, tank type, and tank construction, have been discussed. The relation of each factor to the general planning problem was pointed out. Now, the remaining factors, tank fittings, distribution piping, pumping equipment, and emergency controls, will be investigated. Their relation to, and importance in, usual design work will readily be seen.

Tank Fittings

Successful operation of power plant fuel oil systems is dependent, to a great extent, upon tank fittings. Usual fittings include pipe connections, vents, gages, heating coils, thermometers, and drains. Experience has shown that carefully specified and detailed fittings permit trouble-free operation of fuel oil systems. "Loose" specifications which do not call for approved fittings and vague drawings are to be avoided because operating troubles are almost certain to result.

Pipe connections for fill, suction, and vent lines up to 1½ in. diameter should be made with standard nozzles riveted or welded to tank shell. If desired, pipe couplings welded to shell can be used instead. For lines larger than 1½ in. riveted or welded flanged nozzles must be used. If tank is weakened by the opening for pipe connections a reinforcing pad should be riveted or welded around each opening. Where pipes must extend into the tank a standard pipe coupling welded to both sides of the shell makes a satisfactory connection.

When there is a possibility of tank settling, pipe connections are usually made with soft temper copper tubing. Flanged compression fittings from ⅜ in. to 1½ in. inside diameter are used for oil pressures up to 100 psi. With this type connection any settling which occurs is absorbed by bending of the tubing. Settling occurs most often in underground tanks.

Connect fill pipe to top of tank and provide a trap inside tank or run pipe down to a point below suction opening. These precautions are necessary to prevent escape of tank vapors during filling. In regions with severe winter weather the fill line trap should be provided with a steam heating coil to prevent oil freezing. Long fill lines, 50 ft or more in length for oils with flashpoints below 110 F, should be provided with both an extended fill line and a trap. Frequently a "deflector elbow" is screwed to the end of the inlet line inside the tank. This elbow directs the oil stream to the side of the tank. Splashing and vapor losses

Table IV

RECOMMENDED THICKNESSES FOR UNDERGROUND TANKS AND TANKS IN BUILDINGS (NBFU)

Tank Capacity, Gallons	Minimum Plate Thickness, U.S. Std. Gage or Inches
Up to 285	16 gage
Up to 560	14 gage
Up to 1,100	12 gage
Up to 4,000	7 gage
Up to 12,000	¼"
Up to 20,000	5/16"
Up to 30,000	⅜"

RECOMMENDED THICKNESSES FOR HORIZONTAL ABOVE-GROUND TANKS (F.M.)

Tank Capacity or Diameter	Minimum Plate Thickness
50 gal	16 gage
275 gal	14 gage
36 in. to 72 in.	3/16"
73 in. to 120 in.	¼"

For vertical outdoor above-ground tanks (NBFU)

$$t = \frac{hd}{0.450\ e}$$

t = plate thickness, in.

d = tank diameter, ft.

h = height of tank above ring being considered, ft.

e = efficiency of vertical joint in ring being considered.

are reduced because oil flows gently down tank side.

Tank truck fill connections should be mounted flush with sidewalk, power plant building wall, or ground, if possible. Danger of breakage by passing vehicles or objects will thereby be minimized. Plainly labelled fill connection covers painted a color corresponding to plant fuel oil piping eliminate unloading errors. Covers may be screw or hinge type, locked to prevent opening by meddlers.

Fill connections used with tank cars are usually mounted alongside siding track. Fill line, which must be at least 6 in. diameter, is run parallel to the track for a short distance and then turned into tank field. Flexible metal hose or steel pipe with swing joints is used for connection between tank car and fill line. A basin or pan with a suitable drain line is necessary under the tank car outlet because some oil is usually spilled during unloading. When not in use basin or pan must be covered to prevent accumulation of dirt which might plug drain.

Type of suction pipe used depends on oil which will be stored, tank type, and location. A plain ended suction pipe which enters tank top and runs down to within 6 in. or so of tank bottom is generally suitable for light oils, Nos. 1 to 4, inclusive. For heavier oils, which frequently deposit sediment on tank bottom, double suction connections are better than single pipes. One line is run down close to tank bottom and the other ended a foot or more above, Fig. 7b. Both lines are valved outside tank. Lower suction is used until sediment plugs line, then higher suction is used until tank can be cleaned. In place of double suction lines a swing-jointed suction line can be used. The swing joint permits raising or lowering of the suction line in accordance with depth of sediment deposit.

Fuel oil tank vents prevent vapor binding during filling, permit emptying, allow escape of vapors formed during oil heating, and relieve internal pressure when overfilled. Vent pipe size and length are the most important aspects in tank planning. Undersizing of vents may cause tank rupture from excessive pressures during filling. Vertical above ground tanks generally require large vents than equal capacity horizontal tanks because they are not constructed to withstand as high pressures. Recommended vent pipe sizes for horizontal and vertical tanks are listed in Table V.

Vent pipes must be as short as possible to avoid large friction losses. Maximum allowable vent pipe length is 20 feet for large underground tanks. Vents for vertical aboveground tanks are goosenecked directly above tank roof. Indoor tanks are always vented outside the power plant building to reduce fire hazards. A common vent line connected to several tanks is seldom satisfactory. An independent vent line is best and one should be provided for every power plant fuel storage tank.

When tanks are located adjacent to combustible materials flame arrestors must be attached to outside end of vents. Only approved flame arrestors may be used on insured tanks. Most common type consists of two layers of non-corrosive wire cloth made of No. 30 wire, 30 mesh. Other types combine vent, flame arrestor, vacuum relief valve, and pressure relief valve. Type to be used depends on space available, cost, and underwriter's requirements.

Gages available for power plant fuel oil storage tanks vary from the simple stick type to the hydraulic transmission type suitable for remote reading. Type to be used, rod, float, hydrostatic, magnetic, or transmission, depends upon tank location, amount of money which can be invested, and personal preferences. The remote reading gage is most convenient because it can be mounted in the boiler room and readily checked. It usually is, however, slightly more expensive than simpler types. Gages mounted on or in the tank are generally cheaper but require more leg work by plant personnel. One advantage of these gages is that fuel tank is visited more frequently than with remote reading type. Hence, tank damage is more likely to be observed before trouble results.

Heavy oils require heating before they can be pumped to the burners, Fig. 8. Steam heating coils must be carefully designed to avoid overheating oil in the tank. Oil temperatures over 100 F may cause vapor formation with resultant loss. Locate steam coil low, near tank suction line. A metal box built around the coil will usually prevent undue circulation of oil in the tank and will confine heating to oil going to the pump. Vapor formation is retarded because only that oil which will soon be used is heated.

Fig. 6. Outdoor vertical above-ground oil storage tanks. Fill line appears at the left. Neglected condition of the tanks shows why every safety precaution possible must be taken during system planning

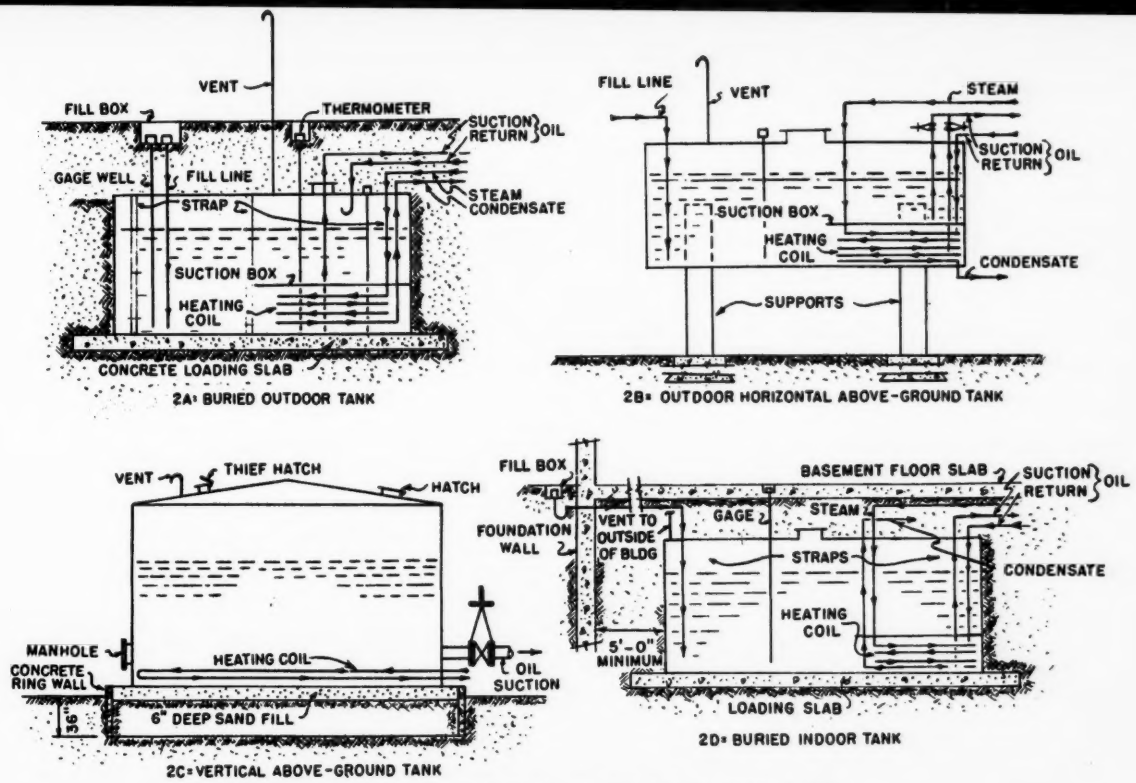


Fig. 7. Typical tank arrangements for power plant fuel oil storage systems

Provide sufficient trapping capacity for coil. Traps sized on coil "warm-up" basis will usually handle normal heating load with capacity to spare. Steam and condensate lines should enter and leave top of underground tanks, Fig. 7a. Condensate line may leave bottom of above-ground tanks, Fig. 7b and 7c.

Oil temperature readings taken in vicinity of heater permit a ready check on its operation. Do not permit thermometer to contact oil. Instead use a capped pipe extending to tank bottom, Fig. 7a, for a thermometer well. With this arrangement thermometer stem will not become oil coated.

Water drains should be connected to tank top. Bottom drains are seldom satisfactory because freezing of water in pipe often occurs. Provide a hand pump for removal of accumulated water.

Distribution Piping

Oil piping failures have caused more power plant fires than any other piece of equipment. Hence, careful planning of piping systems is of prime importance. Good planning is not difficult when commonsense piping principles are kept in mind. Briefly these are: (1) keep tank top as clear of piping as possible, (2) provide adequate support for all piping, (3) run piping underground, if possible, (4) protect exposed and underground piping subject to injury by passing vehicles and falling objects, (5) keep piping outside of building wherever feasible, and (6) use only approved pipe and fittings.

Oil distribution piping is basically of two types, outdoor and indoor. Each type presents separate planning problems which must be solved in terms of expected conditions inside and outside the power plant.

Indoor piping must be designed for severe usage. Every precaution possible to protect piping from breakage while under pressure must be taken. Buried piping, two feet or more below floor level, is least subject to mechanical damage. Hence, bury indoor pipe wherever possible. When oil piping passes through high temperature areas or heavy manufacturing areas, required safety can be obtained only by burying pipe.

When oil piping must be run exposed in a building, keep it high and close to beams, walls, or ceiling. In steel buildings clamp pipe

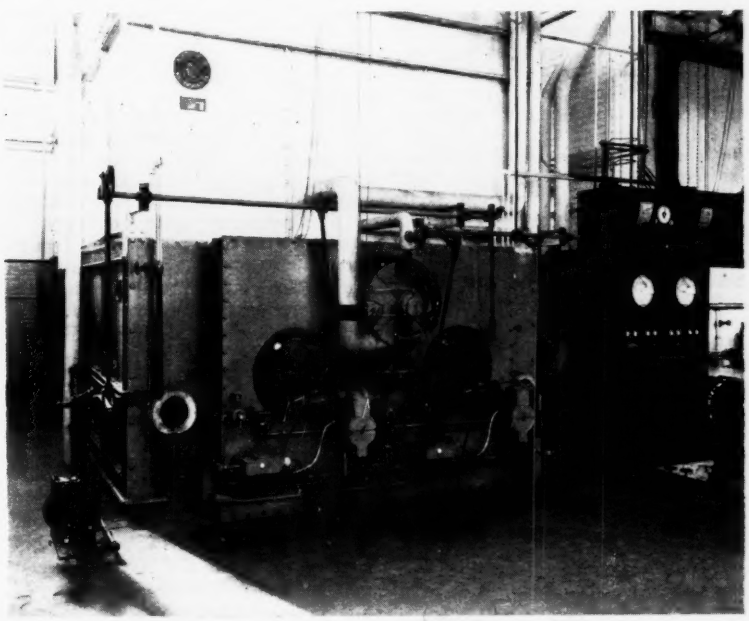


Fig. 8. A neat industrial oil burning installation. Well insulated oil piping saves heat and insures good combustion at all times. Lower burners are for gaseous fuels

to column or beam flanges using malleable iron or steel clamps. In concrete buildings use expansion bolts for clamp attachment to structure. Never attach clamps or hangers to the structure with temporary fastenings such as nails and screws.

Vertical risers should be located in corners or regions where traffic is minimum. Interiors of reinforced concrete columns are excellent riser shafts. Exposed risers in steel buildings must be protected with the same type fireproofing material used for the columns. Short branch lines tapped off risers and headers are safest when run close to a column, wall or beam. All short branches close to the floor should be protected with a suitable guard to prevent injury resulting from people sitting or standing on them or by passing objects.

As with indoor piping, buried outdoor piping is safest. Corrosion caused by "sour" soil, breakage by heavy loads, and insufficient supports are principal hazards which must be foreseen in careful planning. When corrosive soil is encountered, provide a protective coating or tunnel for buried pipes. The coating can be applied directly to pipe surface or the pipe enclosed in masonry or tile. Oil pipes which may be subjected to heavy loads are best enclosed in a larger, protective pipe. Such loads will be found under roadways, streets, railroad tracks, and building foundation structures.

When oil piping must be run exposed outdoors, it should be kept high enough to prevent damage by fully loaded trucks or railroad cars which may pass under it. Steel pipe supports are not safe for areas where open fires are likely to occur because they may soften and twist out of shape, dropping the pipeline. For this reason they are used only in areas where open fires are unlikely. Concrete posts are best for support of pipes where open fires might occur. Distance between posts should be kept as short as possible and should never exceed twenty-five feet.

Seamless steel, wrought iron, brass, and certain types of cast iron may be used for oil piping. The American Standards Association Piping Code prefers welded joints in oil lines but permits joints made up with bolted steel flanges lapped or welded to the pipe. Oil-proof gaskets or ground joints are necessary between flanges. Cast iron pipe should not be used for oil temperatures above 300 F or pressures over 25 psi. Brass pipe is suitable for oil pressures up to 100 psi, when joints are brazed or screwed. Soft temper copper tubing is suitable for pressures up to 100 psi.

Pumping Equipment

In general, safest location for oil pumps is outdoors or in pump houses separate from power plant building. Location of battery of pumps in the boiler room is usually considered safe if the building is of fire-resistant construction. Never locate an oil pump in a pit. Instead, raise supply so that oil flows to pump by gravity. Unenclosed outdoor pumps should be equipped with weatherproof motors.

Indoor oil pumps supplying burners or boilers are not fire hazards when properly located and protected. A distance of ten feet or more from the nearest boiler is usually considered safe. This distance must be maintained even though the power plant structure is fire resistant. During maintenance and repair work all boiler room pumps should be adequately screened or otherwise protected from falling objects and passing vehicles.

Regardless of type of drive used for oil pumps, an outdoor shut-off is necessary. For steam driven pumps a quick closing valve in the steam line is usually satisfactory. A remote control outdoor switch is generally used for electrically driven pumps. To prevent failure of steam driven fire pumps, oil pumps with two sources of power should be used. An electrically driven and a steam driven pump are usually satisfactory for maintaining oil supply under all conditions.

Best oil pump is that which automatically stops oil flow when shut down. Gear, vane, duplex plunger, and triplex plunger pumps provide the desired automatic shut off. Maximum suction lift should not exceed about 10 ft. Relief valves must be installed in the discharge line of all positive displacement pumps. Relief valve outlet should be piped back to storage tank to prevent accumulation of oil within the power plant.

TABLE V

VENT PIPE SIZES FOR POWER PLANT FUEL OIL STORAGE TANKS

Capacity of Tank in Gallons	Vent Pipe Size, Inches	
Horizontal Tanks		
	Above-Ground Tanks	Below-Ground Tanks
1,000 to 3,000	2	1½
3,000 to 6,000	2½	1½
6,000 to 12,000	3	2
12,000 to 25,000	3½	2½
Vertical Above-Ground Tanks		
Capacity of Tank in Gallons	Tanks for fuel oil having a flashpoint greater than 110 F	Tanks for fuel oil having a flashpoint less than 110 F
25,000 to 50,000	One 5 in.	One 10 in.
50,000 to 100,000	One 6 in.	Two 10 in.
100,000 to 200,000	One 8 in.	Three 10 in.
Above 200,000	One 10 in.	Four 10 in.

Emergency Controls

Principal function of emergency controls is prevention of the spread of fires. Best arrangement of emergency controls isolates various sections of the oil system. Boiler room piping is isolated from outdoor piping by rising stem gate valves located outside power plant building. Indoor tanks must be provided with an isolating gate valve. Its stem should be extended through boiler-room window so that operation from outdoors is possible.

Anti-siphon, automatic excess-flow, and fusible link valves are other types which often are useful as emergency controls. For No. 3 and lighter oils, an anti-siphon valve installed at high point in suction line prevents oil flow after pump shut-down or breakage of line. This valve must be used with centrifugal pumps because oil can flow through these pumps when they are shut down. An anti-siphon valve is unnecessary for other type pumps when they are located above tank top. When 5 to 10 ft below tank top, the anti-siphon valve must be used.

Automatic excess-flow valves shut when flow rate exceeds safe amount. They are used principally in short branch connections subject to breakage. Although satisfactory for emergnecy service, adequate protection of branches from mechanical injury is usually better. Fusible link valves close automatically when temperature in region of valve exceeds a safe value. They are especially useful around the boiler burner where a flare-back may cause a fire. The fusible link melts

and a weight closes the valve.

Foam systems for tank fire protection are fully specified by various governing bodies. Hence, in storage system planning it is best to specify protection devices in accordance with local regulations. The tank builder will then provide necessary fittings. When tank shop drawings are sent in for checking, the necessary water pipe connections can be shown on storage system drawings. This procedure insures installation of proper tank fire protection equipment.

Application of the suggestions as given in this article will result in safer, more dependable, and more efficient power plant fuel oil storage systems. Since any savings which result will be spread over a period of twenty years or more, time spent in careful planning is well worthwhile.

Questions and Answers

Q & A—THE POWER ENGINEER'S FORUM—HERE'S HOW IT WORKS

YOU HAVE a question about some detail of power plant operation, maintenance, design. You can't find the answer in your own experience nor in the books. So you write in to our editors. If we know the answer, we send it right back to you. (Maybe we don't know the answer either, but we usually know where to get it for you.)

In any case, we publish your question, signed only with your initials. We do not reveal your identity. Dozens of engineers write in to us, giving their answers. We forward you copies of the replies as soon as we get them.

You, too, co-operate with other engineers by answering their published questions in the same way.

Then, so far as space permits, we publish those replies as soon as possible, so that everybody will learn what the others know about the problem. We pay well for all answers published. And those who answer get credit for knowing.

Simple, isn't it? And effective? Just ask the power engineer who has tried it!

Engineers who take the trouble to answer your question would appreciate some information from you, transmitted through the Q & A editor, on how their answers helped solve your problem. In doing this, indicate whether or not your comments could be published for the benefit of all readers.

Question No. 441

WHO CAN HELP THIS ENGINEER PUMP COLD MOLASSES?

How HIGH can a good steam pump lift molasses at a temperature of 40 F? (Reciprocating pump, we assume he means.—Ed.)

This molasses weighs 12 lb per gal, 45 Baumé, 86 deg Brix.* I do not know the viscosity at 40 F but I know the molasses moves very slowly at that temperature.

Do you know of any formula or method for figuring the possible lift of molasses at different temperatures, also the discharge pressure necessary to deliver 400 gal of that molasses through a 10-in. pipe line 200 ft long, at different temperatures?

Buffalo, N. Y. V.L.G.

Question No. 442

HOW MUCH PHASE UNBALANCE CAN A GENERATOR STAND?

IN OUR PLANT we have an 1875-kva, 1500-k, 3600-rpm, 2400-v, 60 cycle, a-c turbine generator.

Recently, standing in front of the switchboard, I noticed the following ammeter readings:

Phase 1: — 500 amp
Phase 2: — 300 amp
Phase 3: — 500 amp

After watching this for a while, I looked at the generator nameplate, which stated the machine was rated at 451 amp per terminal.

I asked the chief electrician if the indicated unbalance was likely to result in generator damage. He said no. The operating engineer, however, says that not over 10 per cent unbalance is permissible for any great length of time; better still, he says, we should have a differential relay that would trip the machine when the unbalance exceeds 10 per cent.

The above condition has been allowed to continue for several hours and, in some cases, for several days. The major load on this generator comes from welders, both motor generator and transformer types.

What do Q & A readers think of this condition? Will it harm the generator? How much unbalance will this or other generators stand and for how long?

Mt. Vernon, Ill. A. R. E.

Question No. 443

WITH PRESSURES HELD CONSTANT, HOW CAN YOU INCREASE REFRIGERATION?

IF SUCTION and discharge pressures are held constant on an ammonia compressor driven by a constant speed motor, how can you obtain additional refrigeration from the compressor? What can be done to secure varying amounts of refrigeration from such a compressor?

Long Island, N. Y. J. B.

Editor's Note: —This sounds like an examination question to us. But see how many of these methods you can tell J. B. about.

Answer No. 438

HOW MUCH CAN APPLIED MOTOR VOLTAGE BE VARIED WITHOUT DAMAGE?

WHAT IS the effect, asked M.N. in the April issue, of connecting a 440-v, 3-phase, 60-cycle, 0.8 pf, 10-hp standard motor (40 C temperature rise) to a 550-v supply line? How would that affect: a—horsepower; b—power factor; c—efficiency; d—heating; e—motor life? How would those factors be affected by connecting the motor to a 660-v, a 330-v or a 220-v line?

Comments by von Dannenberg

It is not "common to see a 440-v motor connected to a 550-v line," except possibly for a temporary period or with some voltage modifying equipment. No manufacturer, at least, will assume the responsibility of continuous operation for "a standard 1948 model, 40-deg temperature rise" motor for this application requiring continuous service.

Answering the questions in the order given:

a. The rating is still 10 hp, except for short intermittent intervals.

b. The power factor at a higher voltage would be less, something in the order of the increase in voltage; what it actually might be could only be estimated by the designer or one having knowledge of the design constants, flux densities of the iron, etc.

c. The efficiency might be slightly higher.

d. At over voltage, in this case 25 per cent, the no load iron losses (core losses) would be much higher in proportion to some power of the voltage ratio. So, maintaining the same ampere current flow, the total losses would be higher and hence a higher temperature rise might be expected even at the same horsepower rating since the current losses (I^2R) would decrease as the square of the current while the iron losses might increase, depending upon the design details being of the order of the 4th power or even higher ratio of the voltage increase. This, again, is an intangible, essentially within the knowledge of the motor designer alone.

e. Whether the motor would "last longer or not" would depend upon the actual operating temperature existing since the estimated life, say 30 yr at a guess, is based upon a maximum total temperature. In addition, operation at a higher voltage might, in a closely-designed motor,

* The Brix scale is an arbitrary scale for direct conversion of the reading of a saccharometer, which measures the amount of sugar in a solution, into its specific gravity. It is well known to chemists.

Table by C. W. Hope showing general effects on motor operation of increase and decrease in applied voltage

	10% Voltage Increase	10% Voltage Decrease
Torque	21% increase	10% decrease
Slip	17% increase	23% increase
Speed	1% increase	1.5% decrease
Efficiency	½ to 1% increase	2% decrease
Power Factor	3% decrease	1% increase
Current	7% decrease	11% increase
Temperature Rise	3C decrease	6% increase
Overload Capacity	21% increase	19% decrease
Starting Torque	21% increase	19% decrease

have an effect upon the life of the insulation.

If connected to a 660-v line or 50 per cent over voltage, it is doubtful whether any long life, approximating the 40-deg value life, could be expected.

The operation at 330-v and 220-v would result in a decided drop in horsepower capacity in proportion to the decrease in voltage, maintaining the same maximum current value; in other words, the horsepower at 220-v would not be more than one-half the 440-v rating, plus probably additional reduction thru drop in speed.

Brooklyn, N. Y. C. O. VON DANNENBERG

Comments by Hope

VOLTAGE variations vary the torque of a motor as the square of the voltage.

(a) The motor would be rated at 15.625 hp with 550 v. Voltage increase from 440 to 550 is a 25 per cent increase. Torque = $(1.25)^2 = 1.5625$ or 56¼ per cent more.
Hp = 10 + 5.625 = 15.625 (or 10 × 1.5625)

Note—If the motor were loaded to 15.625 hp it would soon burn out; but if it continued at 10 hp, it would not.

(b) The power factor would decrease 10 per cent to 12 per cent at 10 hp because of a higher magnetizing current (c, d & e @ 10 hp)

Comments on c, d and e assume motor develops 10 hp.

(c) The efficiency would increase about 2 per cent.

(d) There would be overheating.

(e) Motor life would be shorter because of running at a higher temperature continuously.

At 660 volts the following would hold true: (a) Hp = 22.5 because torque = 225 per cent. (b) P.f. would be more than 12 per cent lower (at 10 hp). (c) Efficiency about the same (at 10 hp). (d) More overheating than at 550 v (at 10 hp). (e) Shorter life than at 550 v (at 10 hp).

At 330 v (25 per cent lower than normal) and all at 10 hp. (a) Hp = 5.625 (Torque = $(0.75)^2 = 0.5625$). (b) P.f. = higher than normal. (c) Efficiency lower than normal. (d) Severe overheating. (e) Motor would burn out.

At 220 v (50 per cent lower voltage): (a) Hp = 2.5 (Torque = $(0.50)^2 = 0.25\%$. (b), (c), (d) & (e) slightly worse than at 330 v at 10 hp. If only 2.5 hp, motor would run almost normally.

The practice of using a 440-v motor on a 550-v circuit is not too harmful if not loaded above its rating. It will run hotter, but not enough to harm it except over a period of time during which the insulation deteriorates.

Most motors will run without injurious heating with a voltage 10 per cent above or below normal or with a frequency variation of 5 per cent or a combination of both, where the sum of voltage and frequency variations does not exceed 5 per cent.

Table shows some effects with full load and indicates that a slightly higher voltage is beneficial.

Chelmsford, Mass. C. W. HOPE

LETTERS TO THE EDITORS

(Continued from page 53)

in the average laboratory to ascertain a fair estimate of these materials, but only actual combustion will give the proper answer. For extreme accuracy in checking, the boiler house must be equipped with numerous meters, and gauges, such as steam produced, used, oil consumed, combustion and stack temperatures, etc. Unfortunately these are not always available but visual observations will soon tell the answer to an experienced operator.

Some of the additives I have checked that had little value are listed below:

1. An alcohol type, this material did not dissolve, but remained on top of the oil in a storage tank, where it did no good.
2. A sulfonated oil, that as soon as it touched water, lost its ability to mix with the oil.
3. Naphthalene dissolved in fuel oil distillate, did not have the solvent power.
4. Naphthalene and caustic soda in powder form, did not have the solubility to mix with the oil.
5. A type that precipitated a black viscous sludge as described in my original article. The sample of the material received from the supplier was quite small and the solubility test was the only one conducted. Type or composition of material was not obtained.

Fuel oil additives composed of coal tar distillates or their derivatives appear to give the best results. One manufacturer stated that his material was composed of 11 different substances.

The claims that have been achieved are listed below, and are observations by experienced operators and firemen:

1. Clean storage tanks
2. Easier starting, no flash back
3. Less sparking
4. Less soot and smoke
5. Clean combustion chamber, no carbon formation on walls
6. No carbon on burner tips
7. Cleaning of lines, where there has been an excess of sludge or gum

With these advantages obtained, it means better combustion, which in turn will increase the Btu and lower the fuel oil consumption.

These claims have been obtained by constant and continued use, after the additive had a good chance to permeate throughout the oil. As the amount of treatment used is small, it takes time to work or condition the oil for satisfactory results.

I will list some of the laboratory tests usually conducted on these additives. Some of them bear no relationship to the effectiveness of the material, but only conducted to obtain some information as to type or composition. Our laboratory is not too interested in composition, as it is to the practical value, so we do not "Tear it apart".

Gravity and weight.
Flash, open and closed cups
Pour point
Viscosity reductions
Distillation
Solubility in all grades of fuel oils, No. 1-2-3-4-5-6
Solubility in water
Aniline Point

BSW test by centrifuge using the additive in place of the benzol, to determine any precipitation of gum, resins, etc. with residual oils.

Emulsion test, which is conducted by mixing 98% oil, 1% additives and 1% water in a 4 ounce bottle, heating to 100 degrees and then shaking for 2 minutes. The size of the water drops in the emulsion is noted, as well as the time of separation.

Solvency on various types of sludges, obtained from the bottoms of storage tanks.

Paul F. Schmidt
Chemist, Allied Oil Company, Inc.
Cleveland, Ohio

Table I. Recommended characteristics of new oil for industrial steam turbine sets

Physical Properties	(a) Geared Sets & Oil Ring Lubricated Bearing	(b) Direct Connected Sets
Saybolt Vis. SSU		
At 100 F	270 — 325	140 — 170
At 200 F	47 — 51	43 — 45
Acid No., Max.	0.1	0.1
Flash Point, deg F, Min.	350	330
Fire Point, deg F, Min.	390	370
ASTM Steam Emulsion No., Max.	150	120
Corrosion Test	No rust	No rust
Oxidation Test Hours, Minimum (Acid. No. 0.25)	1000	1000

In case you do not have turbine oil testing facilities available, or desire to supplement the facilities you do have, names of established, independent testing laboratories equipped to carry out all these oil tests will be furnished by the Editors on request

These Tests Help You Get the Right Oil for Industrial Steam Turbines-and Keep it Right

Recommended characteristics of new oil for industrial turbines . . . These characteristics may be tested by standard methods, codified by The American Society for Testing Materials, agreed to by users, oil suppliers, manufacturers . . . How viscosity, acid number, emulsion number, fire and flash point, affect oil performance in the turbine . . . Comparisons of non-inhibited oils with rust- and oxidation-inhibited oils . . . Inhibited oils solved many problems in recent years . . . Details of rust and oxidation tests . . . How to interpret test results to show remaining life of inhibitors, when to change to new oil, when to add inhibited make-up to prolong life of present oil . . . This article is Part III of a four-part series beginning in April

By **FRANK C. LINN** General Electric Co.

A TURBINE OIL should have long life and function continuously in the quadruple role of lubricant, surface protector, coolant, and hydraulic medium.

Recommendations in table I cover only those characteristics of a turbine oil for which laboratory tests have been adopted as standard. In addition to supplying an oil to meet these characteristics, it is the responsibility of the oil supplier to furnish a lubricant that will meet service requirements and give long life.

Viscosity[1]

Viscosity of a lubricant may be considered as its resistance to flow. Liquids with higer viscosities have greater resistance to flow than do those liquids of lower viscosities. Bearing loss varies with the oil viscosity:—the higher the viscosity, the more the loss.

Figure 1 shows the viscosity temperature curves of the two oils shown in table I plotted on a special ASTM chart.[2] The viscosity of these oils changes quite rapidly with temperature and also the viscosity increases with a decrease in temperature.

A lubricant is used in turbines

[1] Viscosity By Means of the Saybolt Viscosimeter; ASTM Designation:—D88.

[2] Standard Viscosity-Temperature Chart for Liquid Petroleum Products; ASTM Designation:—D341.

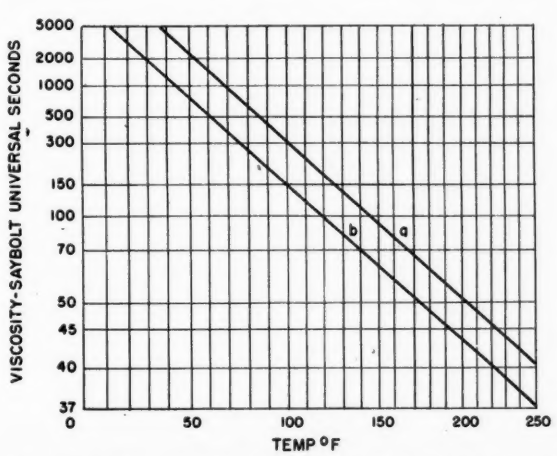


Fig. 1. Viscosity-temperature chart of two oils a and b referred to in Table I

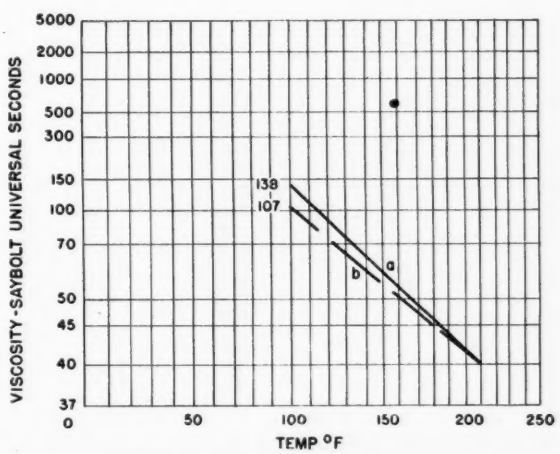


Fig. 2. Viscosity-temperature chart of two oils. Viscosity index for a is 0, for b is 100

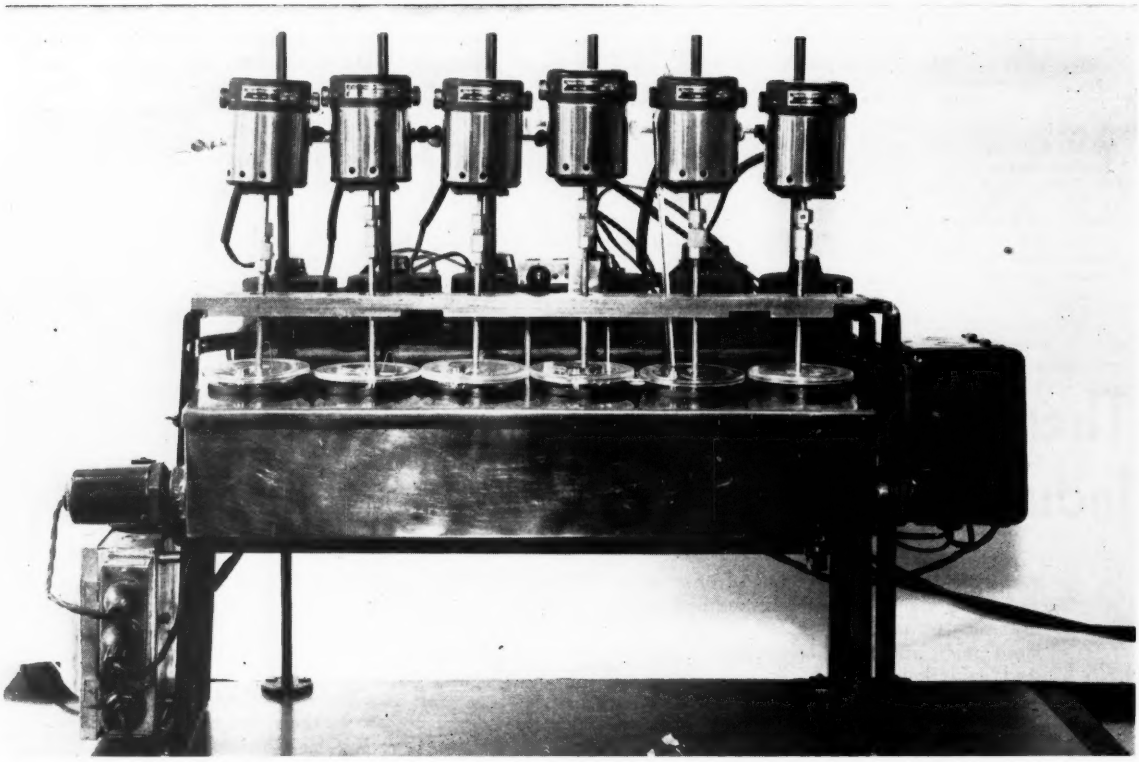


Fig. 3. Test apparatus for determination of rusting characteristics of turbine oils. Each cell, made up as in Fig. 4, tests one sample.

and turbine geared sets in order to separate metallic parts which are moving relative to each other. The film between the two surfaces is produced by the relative movement of the two surfaces and the viscosity of the lubricant. Experience has taught us that an oil with the viscosity characteristics of those called for in Table I and Fig. 1 will allow for satisfactory bearing and gear performance when operating with the cooler oil outlet temperature of 110-120 F when the unit is operating at speed and with the cooler oil outlet temperature of 90 F when the unit is starting and stopping or on turning gear.

During starting and stopping, bearings are operating in the thin film region of lubrication and require a lubricant with higher viscosity than when running. We are all familiar with the ease with which a turbine rotor can be rotated by hand when cylinder oil is poured into the bearings. Although this is not a recommended practice, because of contaminating the turbine oil if too much cylinder oil is used, it does illustrate the desirability of a high-viscosity lubricant during the starting and stopping cycle.

An oil film is produced by the

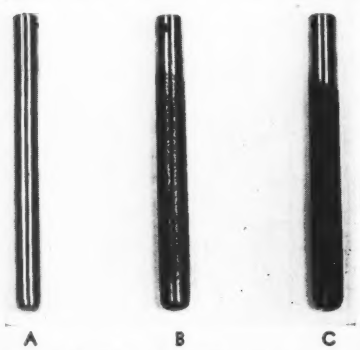


Fig. 4. Results of rusting test on three specimens in three different oils, 48 hr at 140 F: A—inhibited oil; B—improperly-rust-inhibited oil; C—new conventional oil

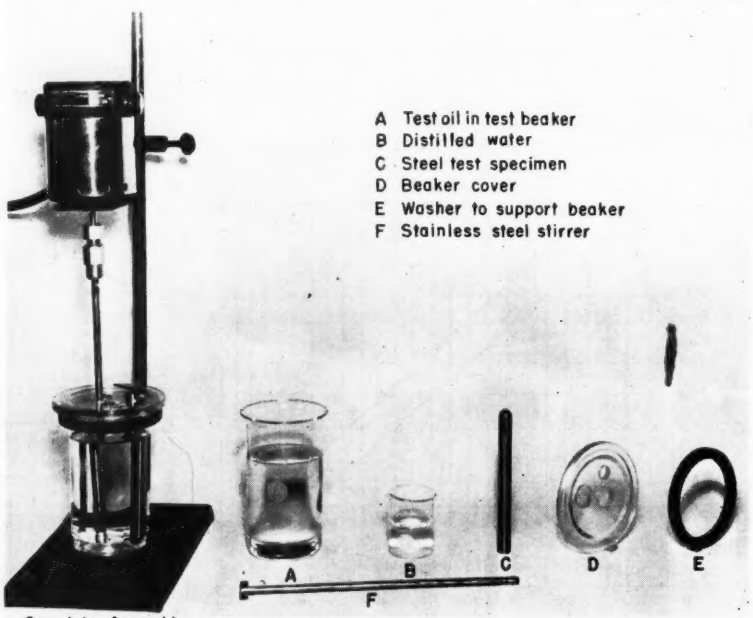


Fig. 5. Assembly and components of a single rusting test equipment for one sample. Several are "ganged" as required by number of samples, Fig. 3

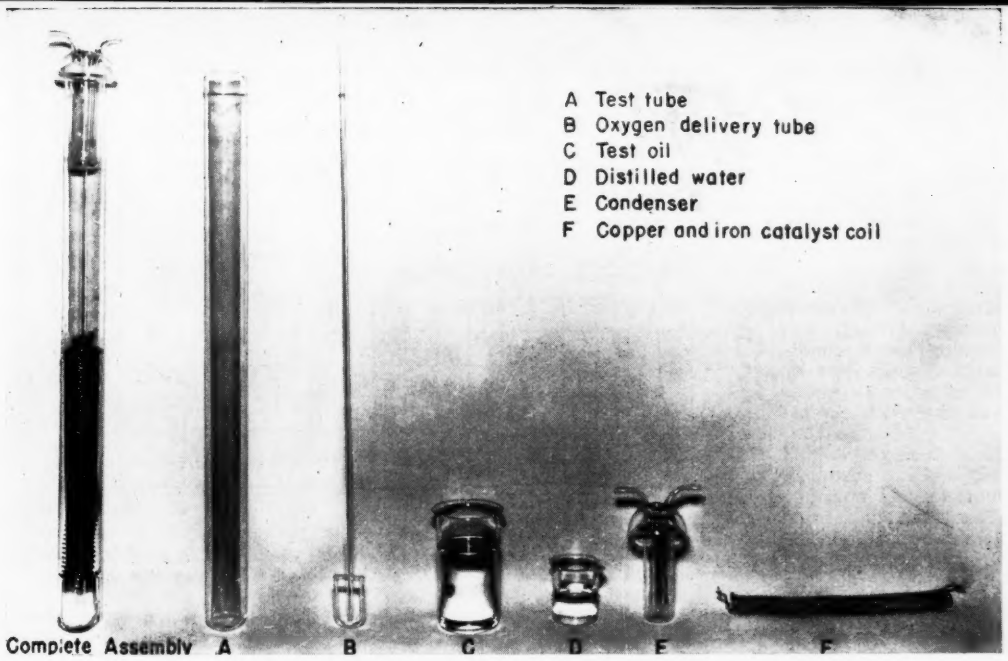


Fig. 6. Assembly and components of oxidation test cell for one sample. As many cells as required for a number of samples may be "ganged" on a test assembly in the same general manner as in Fig. 3. Cells must be immersed in a bath to maintain constant temperature of 95 C (203 F) and oxygen supply sufficient to furnish 3 liters per hr per cell must be available. This is a relatively simple test to make in a laboratory

Table II. Details of Tests for Steam Turbine Oils

You can obtain copies of the ASTM publications describing testing methods, referred to throughout this article, from The American Society for Testing Materials, 1916 Race St., Philadelphia, Penna.

Tests for the usual characteristics of turbine oils such as saybolt viscosity, acid number, flash and fire points, and steam emulsion number have been in use for years and are made by laboratories on samples of new and used oils in accordance with ASTM procedures as indicated previously. Other tests which are being used will be discussed. Names of independent testing laboratories equipped to perform the various tests will be furnished by the Editors on request.

Interfacial Tension

Interfacial tension of oil against water may conveniently be measured by the pull ring method employing the du Nöuy interfacial tensiometer.

Testing of new and used oil for their interfacial tension against water has been used by some operators to determine when they should either change or "sweeten" the oil in the lubricating system.

The interfacial tension of conventional turbine oils will be between 40 to 50 when new and will decrease with age. Sludging may occur at a value of 20 in some cases while in others there will be no sludge formation until values of 14 or 10 are reached.

The interfacial tension of rust and oxidation inhibited oils will be as low as 15 for some and as high as 40 for other new oils. The rust inhibitor usually causes the low interfacial tension reading for the new inhibited oils so there will usually be an increase of interfacial tension reading after the oil is put in service, and then a decrease. The amount of rust inhibitor in the oil after it is put in service decreases due to plating out, so an increase in interfacial tension results. As the oil continues in service and the oxidation inhibitor is used up, the interfacial tension decreases.

Figure 7 shows the change in interfacial tension for a conventional (curve b') and an inhibited (curve a') oil during an ASTM oxidation test. These are typical curves for the oils tested.

Interfacial tension, acid number, steam emulsion number, etc. can be used to assist in determining when the oxidation inhibitor is used up in an inhibited oil and when sweetening or oil change is advisable in a conventional oil. If used, it is recommended it be in conjunction with these other tests and not in place of them.

Corrosion Tests[7]

Figure 3 shows an assembly of the corrosion test and Fig 5 shows the component parts. It consists of an oil bath with heating and temperature control means, a beaker suspended in the bath and holding a sample of oil and water, a stainless steel stirring device and polished low carbon steel test specimen.

The oil sample is held at 140 F to simulate turbine operating conditions. Then 350 ml of oil is put into the beaker and brought to 140 F, with the stirrer rotating at approximately 1000 rpm. The test sample, which has been polished and cleaned, is put in place, Fig. 5. After 30 min. of operation, and while stirrer is operating, 50 ml of oil is removed and 30 ml of distilled water added by means of a pipette through the thermometer hole. The oil and water sample is maintained at 140 F and the stirrer continues to rotate at 1000 rpm for 48 hr.

Figure 4 shows results of testing three samples in three different oils: (a) inhibited oil (b) improperly-rust-inhibited oil (c) new conventional oil.

This is a relatively simple test to make in a laboratory and oils to be used in turbines should pass this test without rust.

The ASTM test procedure includes the use of distilled and sea water. The distilled water test should be used for land installations. This test in modified form was first developed and used by W. F. Kuebler.[a]

Oxidation Test[8]

This method of test as developed is to determine the oxidation life of inhibited turbine oils.

Figure 6 shows the assembly and components of an oxidation test cell. The oxidation cell is immersed in a bath that is maintained at a temperature to keep the oil sample at 95 C. The catalyst coils and oxygen delivery tube are assembled in the test tube and 300 ml of the oil sample is poured over the coils, wetting them completely. The test tube with condenser assembled is inserted in the warm heating bath. The oxygen supply and condenser cooling water are connected, their flows adjusted, and test run for 30 min. This is to get the coils thoroughly wet with oil. Then add 60 ml of distilled water and start test. Maintain the proper bath temperature and a flow of 3 liters of oxygen per hour.

Samples of oil should be removed periodically to make the acid number test.

Curve (a) Fig 7 is a plot of the acid number of an inhibited oil that has been run in the oxidation test. The inhibitor may be considered to be used up at the knee of the curve, i.e., where there is a marked change in the rate of change of acid number.

This test in modified form was first used by Harold Farmer[b] and has been used by consumers and oil companies in the further development of turbine oils. It can be used also in the study of oils in service to determine the remaining life of the inhibitor.

Figure 8 shows the acid number relative to time for a new oil and the same oil after it had been in service for approximately 6 yr. This shows that the inhibitor in the used oil has been approximately half used up. In other words, it may be expected that the oil may remain in the unit for approximately another 6 yr before the inhibitor is used up, assuming operation of the same nature as had been experienced during the past 6 yr.

Reports of oxidation testing on samples of oil taken from the system at yearly intervals should indicate when the oxidation inhibitor will be used up. The operator will then know when he should either change to a new batch of oil or have his oil suppliers add makeup oil with excess oxidation inhibitor, in order to prolong the life of the oil in the system.

[7] Tentative Method of Test for Rust-Preventive Characteristics of Steam Turbine Oil in the presence of water. ASTM Designation:—D665.

[a] "Rusting Characteristics of Turbine Lubricating Oils" by W. B. Kuebler, Mechanical Engineering, pp. 889 to 893, Oct. 1946.

[8] Tentative Method of Test for Oxidation Characteristics of Inhibited Steam Turbine Oils. ASTM Designation: D943.

[b] Copper Catalysis Accelerates Turbine Oil Oxidation" by Harold Farmer, Electrical World, Vol. 111, May 20, 1939, pp. 1452-1453.

action of the shaft and the lubricant when running at a speed of a few hundred revolutions per minute or higher. We are then dealing with thick film lubrication. When turbine units are operating at speed, it is advisable to keep the viscosity of the lubricant low in order to keep the power loss in the bearings at a minimum.

On geared sets, a higher-viscosity oil is used than on direct-connected sets. This is necesary so that, even under the operating speed conditions, an oil with higher viscosity will be present in order to better provide a film at the tooth contact points.

In some stations where geared and direct connected sets are installed, the operator wants to stock only one oil. For such cases, the oil recommended for geared sets should be used.

On the direct-connected sets, the cooler oil outlet temperature can be raised to maintain the viscosity normally used for these sets. To illustrate, refer to Fig. 1: The viscosity of curve "b" at 120 F is 100 SSU and the same for curve "a" at 145 F. This practice is not recommended, since the life of the oil will be greatly reduced. Proper oil for each type of set should be used to obtain minimum bearing loss and maximum service life.

Viscosity Index (V.I.)[3]

The viscosity index (V.I.) of an oil is its slope as plotted on a viscosity-temperature chart. Figure 2 shows two oils; curve "a" has a V.I. of zero and curve "b" 100. The higher the V.I., the flatter the curve. The non-inhibited turbine and turbine gear oils will normally have their V.I. within this range of 0 to 100. The inhibited turbine and turbine gear oils will have their V.I. in the neighborhood of 90 to 110.

Some claim that oils with low V.I. have greatest film strength, while others claim the higher V.I. oils have the greatest film strength. To date no test equipment has been developed that will give measurements sufficiently accurate to substantiate the above claims. In fact, tests of oils of various V.I. on existing equipment for measuring film strength show comparable results. If V.I. has any effect on film strength, it is very slight and of no practical importance.

Acidity

All turbine oils are practically neutral when new. In use they develop a certain amount of acidity, which, in the modern oxidation-inhibited oils, does not increase rapidly until the inhibitor is used up.

The acid number[4], sometimes referred to as neutralization number, of an oil is expressed as the number of milligrams of potassium hydroxide required to neutralize the acids in 1 gram of oil. The change in acid number with time indicates the rate of oil deterioration due to oxidation.

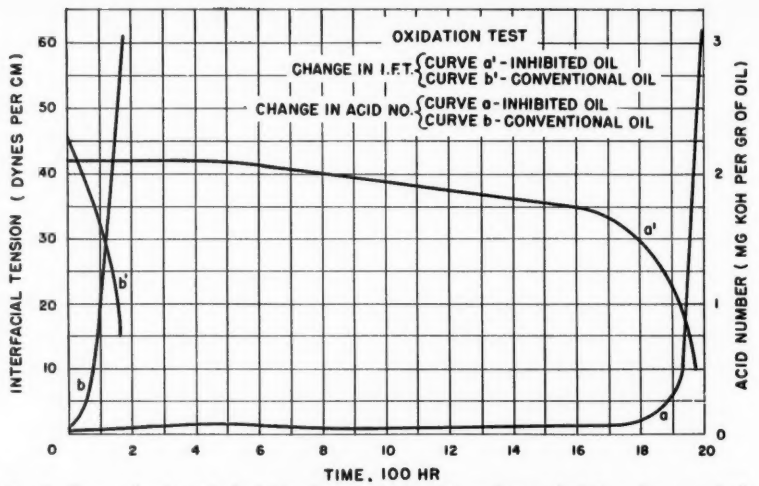

OXIDATION TEST
CHANGE IN I.F.T. {CURVE a' - INHIBITED OIL / CURVE b' - CONVENTIONAL OIL
CHANGE IN ACID NO. {CURVE a - INHIBITED OIL / CURVE b - CONVENTIONAL OIL
INTERFACIAL TENSION (DYNES PER CM)
ACID NUMBER (MG KOH PER GR OF OIL)
TIME, 100 HR
a'
b'
a
b

Fig. 7. Curves showing interfacial tension tests and acid number against time; for: a and a[1] —inhibited oil; b and b[1], conventional oil. Inhibitors considered used up at knee of curve a

Flash and Fire Points[5]

Flash point is that temperature at which the vapor will ignite in the presence of an open flame. The only reason why turbine oil recommendations carry fire and flash points as low as indicated in Table I is the inability of producers to make a turbine lubricant with high values that has other desirable characteristics. Because of the relatively low flash and fire point temperatures, it is essential that oil not come in contact with the hot surfaces of the steam lines and turbine.

Tests on turbine oils indicate that the auto-ignition temperature is 650 F. The auto-ignition temperature is the lowest temperature to which a mixture of flammable vapor and air or a surface exposed to the mixture must be heated to ignite the mixture. Turbine oil will ignite if it comes in contact with hot surfaces at a temperature of 650 F or above.

Steam Emulsion Number[6]

As mentioned in Part I of this article, April issue, a turbine oil must rapidly separate from water in order to eliminate the formation of emulsions. Non-inhibited turbine oils can be produced with steam emulsion numbers in the neighborhood of 25-50. It is somewhat more difficult to obtain steam emulsion numbers lower than those indicated in Table I with inhibited oils. The inhibitors themselves retard the rate of separation of oil from water. Experience is that use of oxidation and corrosion inhibited oils with a steam emulsion number no higher than those in Table I will give satisfactory service in the turbine lubricating system.

The ASTM steam emulsion test,

(Continued on page 86)

[5] Flash and Fire Points, ASTM Designation: —D92.

[6] Steam Emulsion of Lubricating Oils, ASTM Designation:—D157.

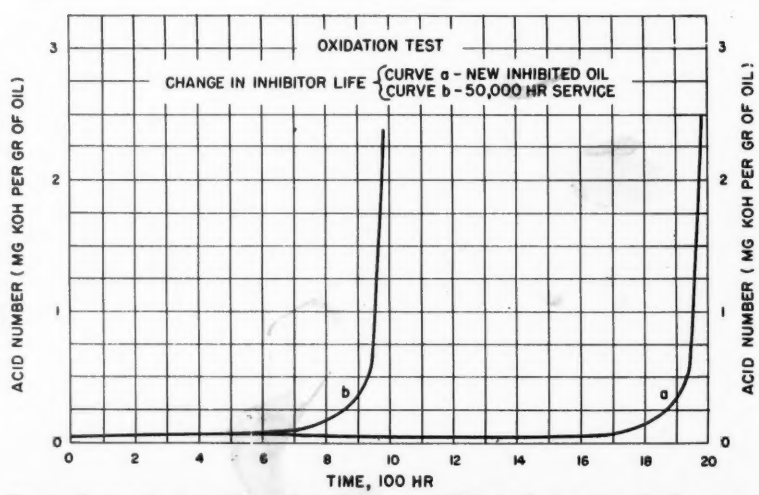

OXIDATION TEST
CHANGE IN INHIBITOR LIFE {CURVE a - NEW INHIBITED OIL / CURVE b - 50,000 HR SERVICE
ACID NUMBER (MG KOH PER GR OF OIL)
TIME, 100 HR
b
a

Fig. 8. Curves showing acid number of: a—new inhibited oil; b—same oil after 6 yr service; to determine remaining life of inhibitor

[3] Standard Method for Calculating Viscosity Index, ASTM Designation:—D567.

[4] Acid and base numbers of Petroleum Oils, ASTM Designation:—D663 and D664.

What Rotating Regulators Can Do For YOU

In article entitled "Industrial Applications of Rotating Regulators" in the April issue, the author described the fundamental principles of Rototrol regulators. Now he describes actual applications to industrial processes

By M. H. FISHER,
Industry Engineering Dept., Westinghouse Electric Corp.

THE BASIC PRINCIPLES of the Rototrol rotating regulator were described in the first part of this article in the April issue. Now, we will consider several applications of conventional Rototrols. First, we will consider the Counter EMF speed regulator. The use of the Rototrol counter EMF speed regulator in an otherwise conventional adjustable voltage scheme gives a speed range far beyond the supposed limits of a few years ago. It is applied where wide speed ranges are required with good speed regulations at all speeds, particularly at the minimum speeds. The most common application of this type, the adjustable voltage planer, is shown in Fig. 7.[1] The motor-generator set (at the right) is of the unit type with the constant potential exciter on the near end and the Rototrol on the far end.

The elementary circuits of the counter emf speed regulator are shown schematically in Fig 8. Note that the circuit does not require a pilot generator to measure the motor speed which results in a space savings about the machine and in a simplification of the electric equipment and circuits.

The speed of the d-c motor is equal to the line voltage minus the IR drop of the motor armature circuit divided by a constant involving the bars, turns, poles and circuits multiplied by the field flux or

$$S = \frac{V - IR}{K\phi}$$

If the motor is excited separately at constant potential its flux may be assumed constant. The motor speed is then proportional to the counter-electromotive force, which is the voltage across the armature minus the resistance drop in its armature circuit. In the circuit shown in Fig. 8, Fields CF and VF make up the pilot intelligence. Field CF is cumulative and aids the pattern field PF in sufficient amount to make up any loss in motor speed due to load. Rototrol pattern fields PF are connected in a bridge circuit with the generator field and perform the double duty of both pattern and self-energizing functions. All legs of the bridge are of the same resistance. The current component I_a flowing from the exciter bus serves as a pattern field current. The current component I_b flowing from the Rototrol armature is the self-energizing component which is created by the regulating effect of Field CF, Field VF and I_a component of Field PF. Currents I_a and I_b are each independent of the other and the algebraic sum of these currents effect the generator fields to provide speed regulations according to the intelligence provided by the pattern and pilot fields.

On applications where it is desirable to hold the speed of the driving motor within very close limits (say ½ of 1 per cent) a pilot generator for measuring speed directly is used in conjunction with the Rototrol. Typical applications of this type of speed regulator include drives for dynamometers, wind tunnel propellers, and paper machines.

The schematic diagram for a Rototrol regulator for precise regulation is shown in Fig 9. A pilot generator is used to measure the drive motor speed and excites the Rototrol pilot field SPF. Pattern field

[1] Figs. 1 to 6 appeared in the first part of this article on page 66 of the April issue.

Fig. 7. Planer with adjustable-voltage drive

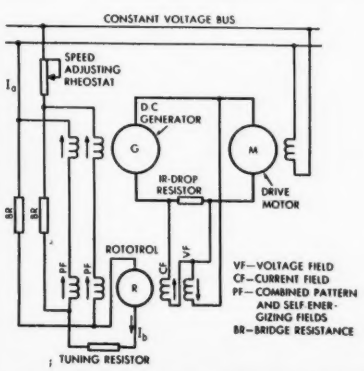


Fig. 8. Schematic of circuit for counter emf speed regulating Rototrol

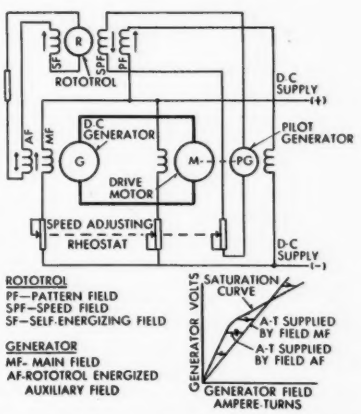


Fig. 9. Schematic for Rototrol for precise regulation

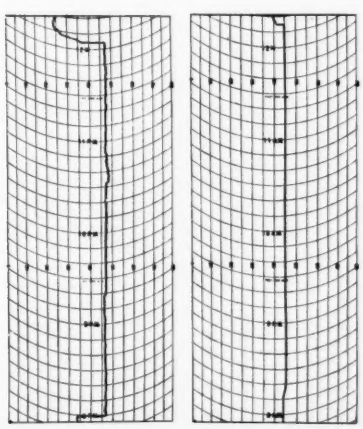


Fig. 10. Speed regulation "before" and "after" (left and right respectively) application of Rototrol for precise regulation

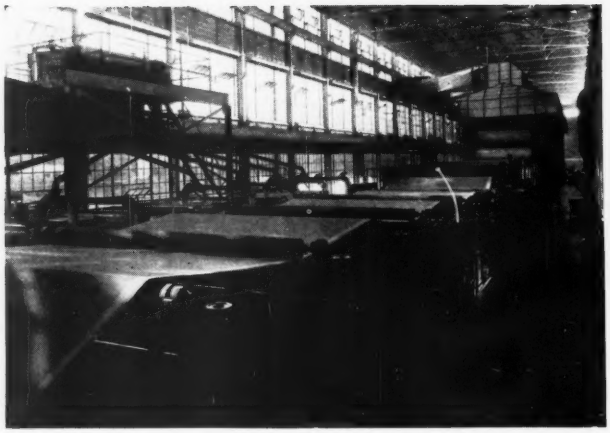


Fig. 11. Single motor driven paper machine with precision type speed regulating Rototrol

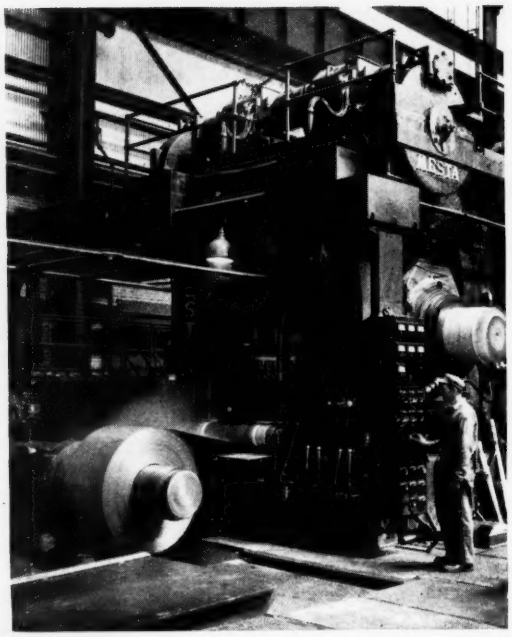


Fig. 12. (Right) Wind-up reel drive on steel strip tandem mill controlled by Rototrol

PF is excited from the exciter bus as is the pilot generator field. These two fields are connected in series to minimize the effect of changes in exciter bus voltage as well as changes due to unequal field heating. The Rototrol excites generator field AF and supplies only the regulating field power. Generator field MF supplies the base excitation of the generator for any speed setting. To assure high sensitivity at all speeds, the speed adjusting rheostat is located in Rototrol field SPF which is served from the pilot generator so that a constant level of forcing excitation is obtained over the entire speed range.

When the drive motor speed is at the correct value, pattern field PF and pilot field SPF balance out. As the motor speed departs from its correct value, the speed change is detected by the pilot generator and is transmitted to the Rototrol pilot field SPF. A difference will then exist between the pilot and the pattern fields which causes the Rototrol to compensate the generator excitation to bring the motor speed back to the correct value.

Operating results with this type of regulator have been excellent. Typical performance is shown by the graphic charts in Fig 10. These show speed regulation before (left) and after (right) application of the Rototrol regulator. The charts were taken on a 250 hp single motor paper machine drive, such as shown in Fig 11, which was modernized by the addition of the Rototrol regulator.

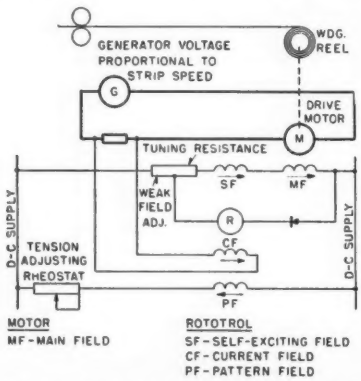


Fig. 13. Schematic for Rototrol for constant tension reel drive

Fig. 14. Electric arc furnace with electrode positioning Rototrol

Current Control—Constant Horsepower

In the steel, textile, paper, and rubber industries there are a large number of wind-up and unwind operations utilizing core type reels such as the Tandem Mill Reel shown in Fig. 12. A drive for such a reel must maintain constant tension in the strip and must change its speed continuously and smoothly as the roll builds up from a small core to a full roll. The Rototrol control is used in conjunction with an adjustable speed d-c motor which has a speed range by shunt field control slightly exceeding the ratio of the full roll diameter to the empty core diameter. Motors applied to reel applications vary from 3 hp 180 fpm slasher drives in textile mills to 600 hp reel drives on 3000 fpm tandem mills as shown in Fig. 12.

An elementary circuit for such a constant tension reel drive is shown schematically in Fig. 13. The reel motor is supplied with a voltage proportional to strip speed either from the adjustable voltage generator serving the main drive or from an auxiliary generator driven at machine speed. The Rototrol modifies the shunt field excitation of the motor to compensate for changes in roll diameter and to maintain uniform strip tension. This is accomplished by maintaining the motor armature current constant and as the supply voltage is uniform at any particular strip speed, the horsepower output of the motor and the strip speed will be substantially constant.

The Rototrol pilot field CF measures the motor armature current and compares it with pattern field PF. Any net difference of these two

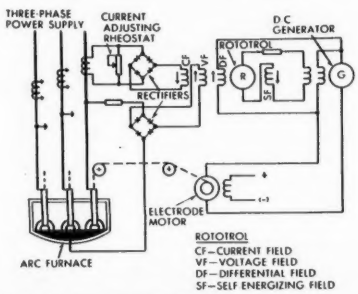


Fig. 15. Schematic for Rototrol for arc furnace electrode positioning

fields will cause the Rototrol to change the excitation of the motor field MF to hold the armature current constant. Note that the pattern field PF is excited in a direction to cause the Rototrol to weaken the motor field MF. To prevent the motor field from being weakened to a value below maximum speed field setting a Rectox copper-oxide rectifier is placed in the Rototrol armature circuit to remove the influence of the Rototrol when the reel is being threaded or a break in the material being wound occurs, and the current in the motor armature is less than the value required to hold the desired tension. The minimum shunt field current is determined by the setting of a resistance in series with the d-c exciter source. The self-energizing field SF is placed in series with the motor field MF to utilize a degree of separate excitation to the extent that when the Rototrol comes into service and starts increasing the motor field excitation there will be a minimum voltage difference between the Rototrol armature volts and the IR drop across the tuning resistance, self field and motor field, thus the Rototrol can take over the control smoothly.

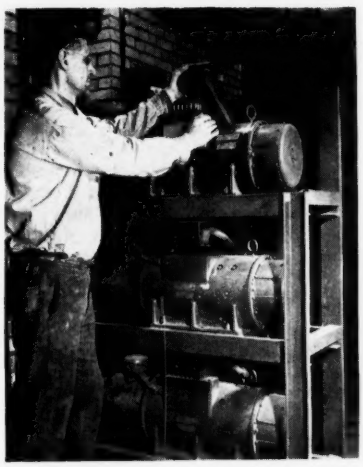


Fig. 16. Three arc furnace Rototrols tier mounted in steel rack. Pinjacks and plug facilitate removal for test or repairs

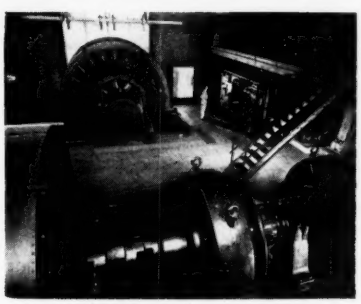


Fig. 17. Blooming mill motor room. Generators are in the foreground, reversing mill in left background, control, exciter and Rototrol under balcony

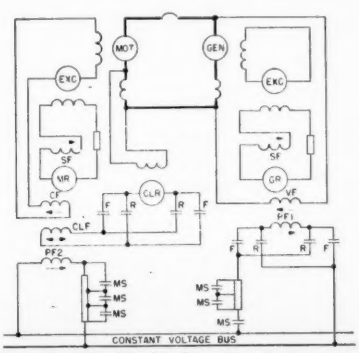


Fig. 18. Simplified schematic of main circuits for blooming mill Rototrol control

Power Control

We have considered Rototrol voltage regulators and Rototrol current regulators. Now we combine the two into a power regulator. Power to an electric arc furnace such as the one shown in Fig. 14 may be regulated, since there is a definite relation between power input and electrode position. Advantages of the Rototrol control over other methods of control are a reduction in electrode breakage and control maintenance, individual automatic positioning of each electrode, reduction of kilowatt-hour consumption and increased tonnage output.

An elementary schematic diagram of the circuit to control one electrode is shown in Fig. 15. The voltage control field acts as a pattern field and tends to cause the electrode to move into the furnace charge. The current control field is connected differentially to the voltage field and tends to cause the electrode to move away from the furnace charge. By correctly proportioning the pattern and pilot fields the net Rototrol ampere turns can be made just sufficient to hold the arc furnace electrode in position to draw a predetermined amount of power. The differential field on the Rototrol is a feed-back field from the generators volts for stability reasons.

Figure 16 shows three are furnace Rototrols, one for each phase, mounted in a rack. Note the plug arrangement which allows an entire unit to be easily removed for repair or test.

Systems Requiring Several Rototrols to Perform Different Functions

Modernization of an old reversing blooming mill by the addition of Rototrol control resulted in a 20 per cent increase in output and a considerable decrease in mill maintenance due to better commutation and smoother operation. Fig. 17 shows the motor room of this blooming mill with the two 2500 kw generators in the foreground, the 5800 hp reversing mill motor in the left background, and the control panel, the exciter and Rototrol sets under the balcony. The latter can be seen beneath the steps leading to the balcony.

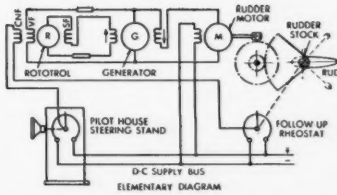


Fig. 19. Simplified schematic diagram of rudder positioning Rototrol

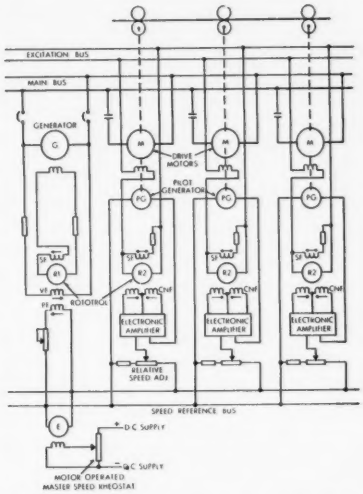


Fig. 20. Basic circuits for electronic Rototrol speed matching control

The elementary circuits used on the Blooming Mill control are shown in Fig. 18. The generator voltage is controlled by the generator Rototrol GR working through an exciter. This for the reason that the generator is so large that to work the Rototrol directly on it would have made the generator Rototrol prohibitively large.

The motor Rototrol MR is a current control Rototrol working on the Main Motor field. By its forcing action, it causes the motor field to quickly change the field flux of the motor. The current-limit Rototrol CLR works on the motor field to strengthen this field when an abnormally high current is drawn during rolling operations. This forces the motor to slow down, thereby providing more torque to do work on the steel. On slow-down during reversal the current-limit Rototrol acts in a direction to weaken the motor field during the regenerative period and limit the peak current.

The control is so interlocked that the sequence of operation for reversal is as follows (assuming the motor running at high speed in one direction and the master switch is thrown as rapidly as possible from one extreme to the other):

1. Motor shunt field is strengthened to a near full field value, the generator volts being held constant by the generator Rototrol.
2. Generator volts are reversed.
3. Motor shunt field is weakened

when a predetermined generator voltage is reached.

Position Regulator

Position regulators are used for positioning milling cutters, for side register of winding reels and for control of ship's steering gear. Although the ship's steering gear is not exactly an industrial application, it is an interesting and easily understood application.

Electric steering gear has been applied to coast guard ice breakers to give increased maneuverability by rapid rudder movement.

Figure 19 shows the simplified schematic diagram of the rudder position regulator. Duplicate potentiometer rheostats are coupled to the steering wheel in the pilot house and to the rudder stock. The Rototrol control field CF is connected between the rheostats moving contacts and becomes energized whenever there is relative displacement between the contact arms. As a result, the generator voltage builds up and causes the motor to turn the rudder in a direction to reduce the displacement. The Rototrol armature circuit is completely self-energized, but the Rototrol is allowed to saturate to limit the rate of rudder travel. Field VF on the Rototrol is used to feedback the generator voltage to the Rototrol in a direction to decrease over-shooting and hunting.

Rototrol-Electronic Regulation

For applications where extreme accuracy and high speed of response are required, the intelligence for the Rototrol control fields is supplied through electronic amplifiers. The partnership of Rototrols and electronics has proven very successful in actual service. Anticipating and anti-hunt features are easily introduced in the low energy electronic circuits.

A typical application is a rod mill where the relative speed of each section must be regulated with great accuracy to prevent damage to the material being processed.

Figure 20 shows the elementary circuits for electronic Rototrol speed matching. Power for the drive motors is supplied by a generator with Rototrol voltage regulation. The drive motor shunt fields are connected across the excitation bus and the field currents are regulated by a series connected buck-boost Rototrol RZ for speed matching. A variable voltage bus serves as the reference for motor speed as well as for generator voltage regulation. Motor speed indication is obtained by permanent magnet pilot generators PG, the voltage of which is compared to a variable fraction of the reference voltage to obtain the correct speed relation between sections. Any voltage difference resulting from an error in speed is impressed on the input stage of the amplifier and causes an unbalance of normally equal Rototrol control fields CNF and a corresponding variation in the motor field to correct the speed error.

Summary

Rotating electrical machinery—motors and generators—has been developed to such an extent that present day advancements are really only technical improvements in the existing basic designs.

In contrast, radical fundamental changes have been made in control apparatus during the past few years to obtain faster response, more accurate performance, and more automatic operation of the rotating machines. The Rototrol is a more recent control advancement which has been highly developed and widely applied. The applications discussed in this article are typical of the many regulating problems which can be solved with the rotating regulator.

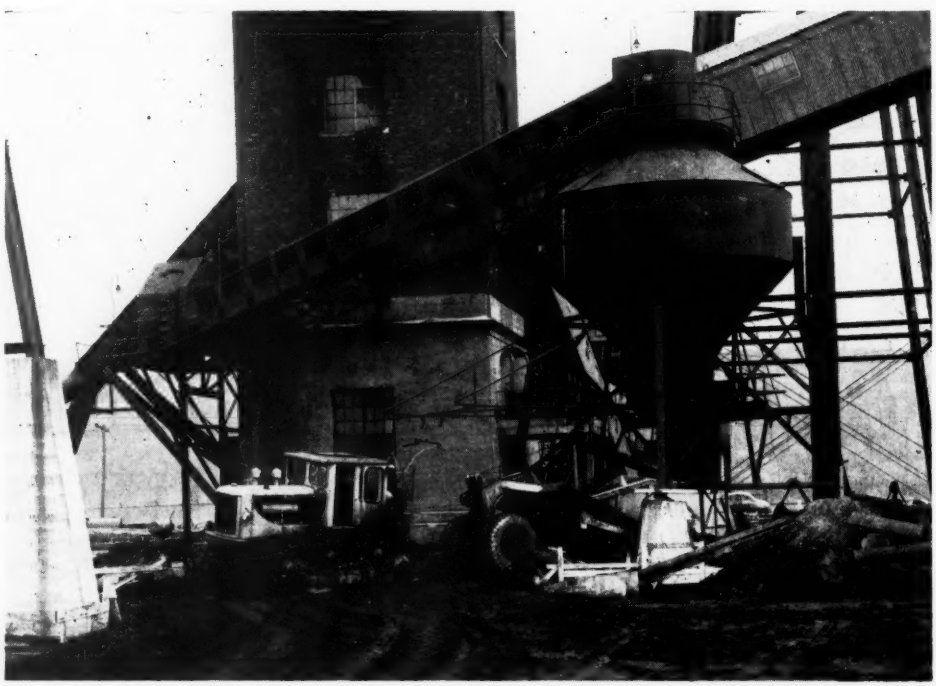
* * *

Further increases in airplane speeds depend upon developments which hinge on the human element, Dr. John T. Rettaliata, dean of engineering at Illinois Institute of Technology, recently told the newly-formed Chicago section of the Institute of Aeronautical Sciences. Technical progress in designing planes which exceed the speed of sound has been so rapid in the past two years that the problem also now becomes one of concentrating on human problems.

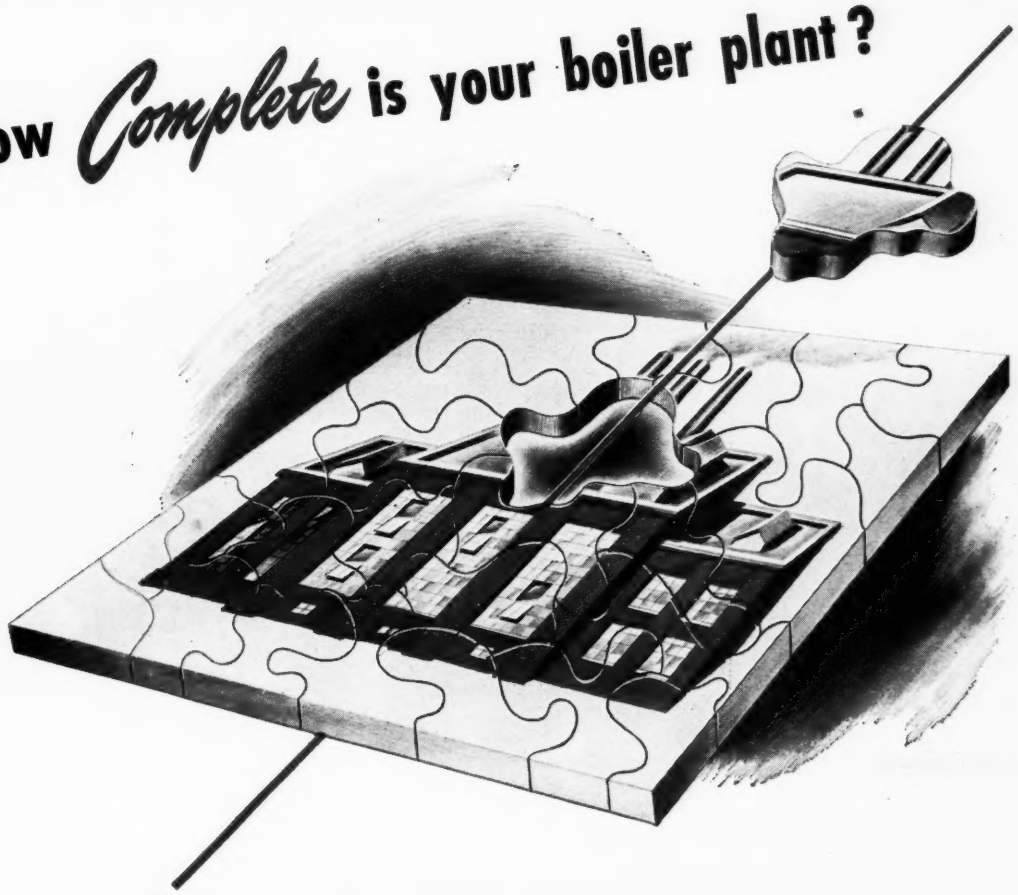
Unless the pilot can survive and remain operative in the plane, further technical advances are impossible.

Antennae Give Automatic Control to Coal Hopper Gate

When antennae mounted on the rear of this Allis-Chalmers crawler contact electrodes, they automatically control the gate on a coal hopper at the Cincinnati Gas & Light Co. yards in Ohio. After a light in the cab signals contact with the electrodes, the operator can control the gate of the hopper without leaving his tractor. Average loading time has been reduced to 10 to 12 sec. Tractor-scraper units replaced an old cable drag shovel which had high maintenance and operating costs plus inadequate performance. After dumping their loads in storage areas, the crawlers spread coal in thin layers and compact it with their own weight.



How *Complete* is your boiler plant?



Insofar as mechanical equipment is concerned, a boiler plant may be complete in every respect. However, completeness of equipment will not necessarily assure most efficient operation of the system. An adequate and well controlled program of boiler water treatment, too, is highly important. A water conditioning engineering service should be an integral part of your picture. We ask, "how *complete* is your boiler plant?"

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RIGHT OIL FOR INDUSTRIAL STEAM TURBINES

(Continued from page 80)

although generally recognized as the best method now available, does not give too consistent results; nor do high readings after an oil is in service necessarily mean that emulsions will form in the system. However, high readings usually indicate contaminants are present and should be removed by the use of the oil-conditioning equipment.

Non-Inhibited Turbine Oils

Non-inhibited or conventional turbine oils have been in use since the introduction of turbines. They have given a good account of themselves during the period when it was expected that a certain amount of trouble could be expected from various parts of the equipment and that it would be essential to shut down for maintenance purposes at relatively short intervals. Rusting of parts in the lubricating system in the early days of the turbine industry was either not present or not recognized. The oils in those years were refined sufficiently to give desired service life but not sufficiently to remove all of the natural rust inhibitors which occur in petroleum crudes.

As time went on, more emphasis was placed upon longer service life before shutting down to clean out the lubricating system; consequently, the refining process was carried on to a much greater degree and most if not all of the natural rust inhibitors were removed from the oil. During the past 10 to 20 yrs, considerable difficulty, as discussed in Part I, has been experienced from the formation of black oxides in the lubricating system.

Rusting took place particularly on new turbine installations where even a small amount of water entered the lubricating system. The practice was adopted, by many turbine users, of adding 10 per cent old oil to the new oil. The used oil had oxidation products in it that were rust inhibitors; that is, they preferentially wet the metallic surfaces so that they prevented water from coming in contact with them. This was satisfactory so far as the rust problem was concerned; but the life of the oil was materially reduced.

Records show that uninhibited oils have been used in turbine systems for years. They have been kept there in many instances by the use of oil-conditioning equipment, which removed most of the oxidation products of the oil as well as emulsions and foreign particles that entered the lubricating system.

The following conditioning equipment has been used with more or less success: — centrifuges, filters, batching tanks, clay filters, and water washing. The purpose of the oil conditioning equipment is to remove water, solid matter, and sludge. In the case of water washing and clay filters, the acid number could also be kept at a relatively low level.

A certain amount of new oil was usually added to the system to keep the acid number within a maximum limit. This limit has usually been placed at 1.0; however, some operators would run their systems with the acid number as high as 2 or 3. This was satisfactory if the system was dry but, if water leaked into the system, trouble from emulsions and sludge usually resulted.

Sludging is a quite common occurrence with the use of these oils. It first plugs the oil coolers and then deposits in other positions of the system; so the unit must be removed from service and a major clean-up job performed. Many operators are familiar with oil systems becoming dirty in from one to three years and having to spend a number of days in cleaning it before putting the unit back in service.

We must not condemn non-inhibited oils but should recognize their limitations and either care for them adequately, to maintain a clean lubricating system, or change to the use of inhibited oils, which have been developed in the last few years.

Inhibited Oils

Modern chemistry has provided a very practical solution to many of our problems. Additives have been developed which in some instances are inhibitors.

To inhibit is to restrain or prohibit. Rust- and oxidation-inhibitors do prohibit so long as the inhibitor is present. The rust inhibitor prevents rusting and the oxidation inhibitor prevents oil oxidation as long as it is present in the oil.

Inhibited oils have been used in turbines since the late '20's. A few oil companies started marketing them in the middle '30's. The vast majority, if not all the oil companies, were producing inhibited turbine oils during the war period and are in a position today to supply turbine users with this product. Some of the early inhibited oils were much more highly refined than conventional turbine oils, so that when the oxidation inhibitor was used up, the rate of oxidation of the oil was very high and in a relatively short period of time, emulsions, sludge, and the like formed. During later years, more stable petroleum products have been developed which will combine satisfactorily with rust and oxidation inhibitors in order to provide an oil which, after the inhibition period, will still give sufficient life so that there is little or no danger from sludge and emulsion formations, provided the oil is changed in a reasonable length of time.

Rust and oxidation inhibited oils have been in turbines operated by the General Electric Co. for over six years with only sufficient make-up to take care of a slight amount of leakage and the oil which has been removed for sampling purposes. The acid number of these oils is still below 0.1. Rusting has never taken place and the oil-conditioning equipment has been used only enough to remove the small amount of water and dirt that accumulates in the bottom of the tank.

Some operators started using oxidation-inhibited oils in the late '30's without rust inhibitors. Severe rusting took place even after months of operation. This shows that the oxidation inhibitor was preventing the formation of oxidation products. In order to overcome rusting difficulties, they added 10 per cent of an old oil. This practice is questionable because the life of the oxidation inhibitor is reduced to less than half expected and a rust inhibitor which has little or no detrimental effect on the oil life will prevent rusting the same as the 10 per cent of old oil.

Inhibited vs. Conventional Oils

For new installations, the following factors should be weighed to determine whether a conventional or an inhibited oil will be used.

An oxidation- and rust-inhibited oil will give long life with a lubricating system free of troubles, assuming normal maintenance with a simple oil conditioning equipment.

A conventional oil will give satisfactory life provided an adequate oil conditioning equipment is provided to keep the acid number below 0.5 and assuming that sufficient oxidation products are left in the oil to prevent rusting taking place.

Some operators, who have a central lubricating system for a power house and have adequate oil conditioning equipment and trained personnel, prefer the use of conventional oils.

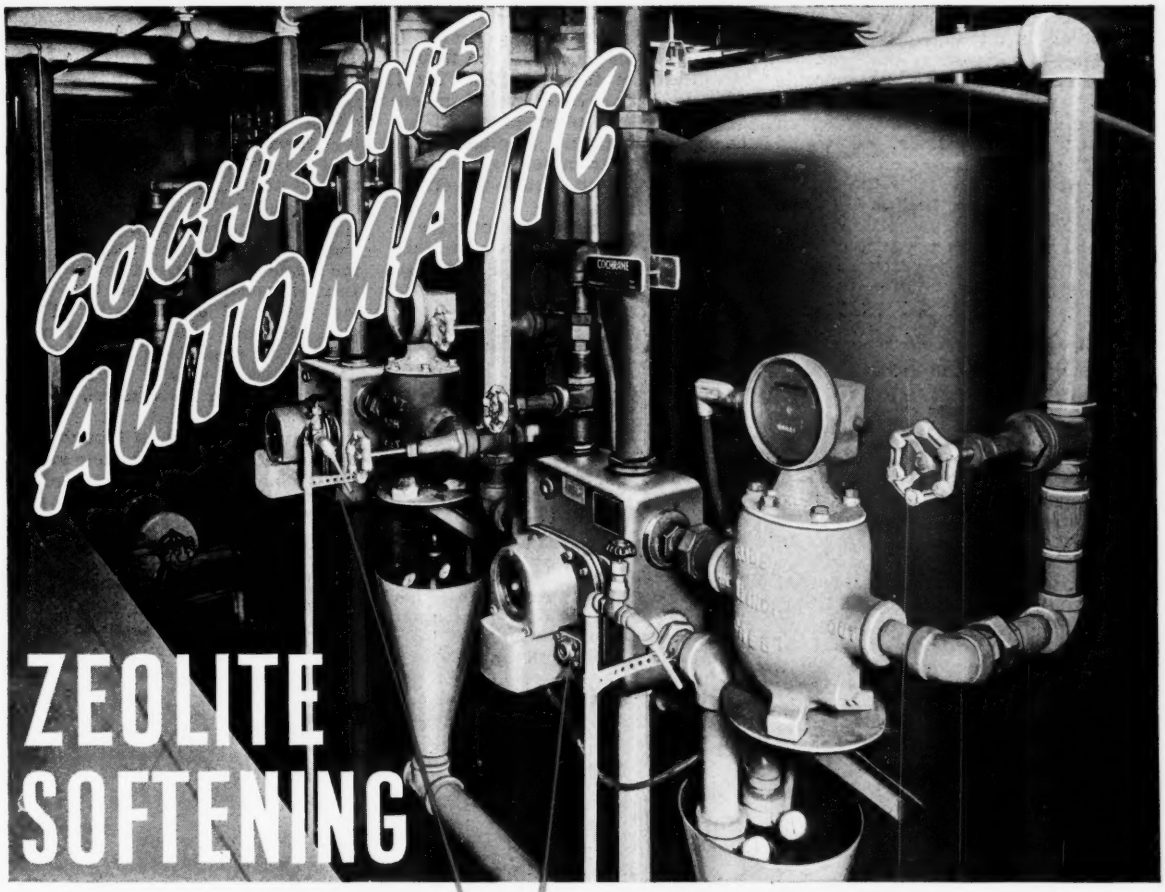
Inhibited oils are very good solvents and should be put into a system only after it has been thoroughly cleaned. There have been a few instances where orifices in the oil line preceding the bearing have been plugged after cleaning a dirty system and then using inhibited oils. There still remained varnish and other solids attached to the metals, which were loosened by the inhibited oil and then carried in the oiling system.

In the foregoing we have considered the long life, lubricating, and surface protecting qualities of an oil. Now we will consider its use as a coolant and hydraulic medium.

Coolant

Heat flows into or away from bearings in turbines depending upon relative shaft and housing temperatures. Heat is generated in the bearings due to shearing the oil. To illustrate, a 10 in. by 7 in. bearing running at 3600 rpm, with a 150-SSU oil at 100 F entering the bearing at 120 F, will have approximately 12 kw loss.

It is desired to keep the rise in temperature between inlet and out-



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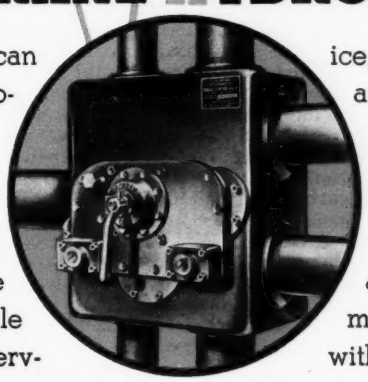

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let from 30 to 40 F. To do this, sufficient oil is circulated through the bearing to carry away the heat.

Oil has a specific heat of approximately 0.45 as against water of 1.0. Other coolants would be preferred to oil; however, their use would complicate the lubricating system unduly.

Hydraulic Medium

Oil is usually supplied to the hydraulic system at a pressure of from 55 to 75 psi. By use of oil pressure and proper relays and valves, the power of the speed governor can be magnified as desired to operate the control valves that limit the flow of steam to the turbine. See Part I.

Oil without excess air entrainment is practically non-compressible and is a good hydraulic medium. With excess air entrainment it becomes compressible and erratic governing may result.

Turbine oils should be capable of rapidly expelling excess entrained air in order to be a good hydraulic medium for turbines.

SOME OBSERVATIONS ON SPREADER STOKERS AND COMBUSTION EQUIPMENT

By IRA A. BUTCHER

GRATE BARS, as manufactured by the various stoker manufacturers, vary greatly in size and shape. In general, it is a safe assumption to say that the majority of traveling grate stokers have grates made up of small sections, usually somewhat less than a foot in length. Other manufacturers use grates made up of sections much longer and of varying cross section.

Let us consider the action taking place in two different sections. First, a short section such as is used on the "chain" grate stoker may look somewhat like Fig. 1. The links fit closely together, probably have air ports along the sides and, as a whole, are of symmetrical form. Links of this type will gradually become crowned on their faces and may burn off their edges. However, the warping must be considerable before the link needs to be replaced.

Another type of grate bar may look somewhat like Fig. 2. This grate may range from 2½ to 3½ ft in length and 6 in. to 10 in. in width, with stiffening ribs 1 in. to 2 in. deep.

In normal operation, this bar passes under the bottom of the drive sprockets, where it is relatively cool and clean, then passes into the combustion chamber where it is covered with fresh coal. If the stoker happens to be of the spreader type, the coal has been thrown through several feet of combustion flame and hot gases before it lands on the grate bar. The coal is burning when it lands on the grate, and the air coming through the grate increases its rate of combustion. As the grate passes through the furnace, its face becomes quite hot, while the ribs and lip, which projects under the adjoining grate bar, are many degrees cooler. This is repeated each time the grate makes a trip.

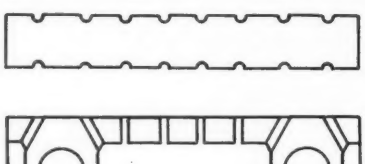


Fig. 1. Short section of grate as used on some chain grate stokers

The result of this difference in temperature is that the grate warps upward away from the ribs and forward away from the cool lip. A small amount of curvature in each direction soon results in a grate bar which must be replaced, while the same curvature on a short grate bar would have no serious effect on it.

Influence of Overfire Jets

It is now well understood that a high degree of turbulence in the combustion chamber is necessary in order to secure good combustion.

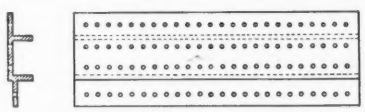


Fig. 2. Another typical section of grate used on some traveling grate stokers

It is common practice to build high pressure jets into both the front and back walls of the furnace to help provide this turbulence. Some stoker manufacturers take the cinders from the cinder traps at the back of the boiler and return them to the combustion chamber by means of a jet of air. This increases the efficiency of the plant by burning the carbon in the cinders and at the same time disposes of the cinders.

It is of considerable importance that the pipes carrying the cinders from the traps to the combustion chamber be perfectly straight throughout their length. If there are bends in these lines, the cinders will cut through the walls of the pipes at each bend, resulting in high maintenance costs.

If the stoker and boiler are purchased under separate contracts there may be some difficulty in coordinating the work of the two contractors to obtain the desired results, but it should be worth the effort.

Another thing to be watched carefully is to see that the cinder return nozzles are so located that they do not blow down onto the fuel bed on the grate. If this happens, the blow-pipe effect of this stream of air is liable to melt the ash down so it forms a clinker. If the main cinder return jets discharge diagonally across the grates, it will reduce the chances of these jets forming clinkers on the grates. The space between the grate and the arch should not be too low, or much trouble may be experienced in removing clinker. You may be told that the particular stoker under discussion burns the coal so perfectly that there are no clinkers to be removed, so 6 or 7 in. clearance is all that is required over the grate at the front end. When you get some extra bad fuel, or a big chunk of cinder falls off the wall, you are going to need more than 7 in. clearance. You will be much happier with 9 in. or 10 in. clearance when the clinkers have to be removed.

Following the line of thought that clinkers do not form on their stoker, some manufacturers have closed the front of the stoker setting with firebrick supported on tee bars, with the bottom of the tee bar exposed. This works out all right until some of those big clinkers arrive; then the supporting ledge of the tee may be burned off so the bricks drop out. This difficulty can be avoided by not exposing the supporting bars to the heat of any clinker or fire on the grate.

ARTHUR E. GRUNERT RETIRES AFTER 40 YR WITH COMMONWEALTH EDISON

Arthur E. Grunert

FOUR HUNDRED friends and associates of Arthur E. Grunert, chief operating engineer of Commonwealth Edison Co., Chicago, gathered at a dinner on May 10 at the Palmer House, Chicago, to honor him on the occasion of his retirement after more than 40 years of service with the company.

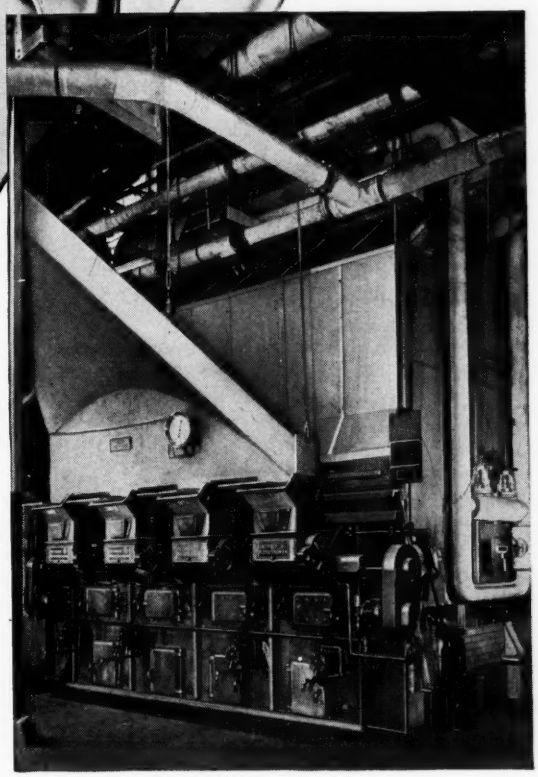
After receiving a mechanical engineering degree from the University of Wisconsin, Mr. Grunert started his utility career in 1908 as a draftsman. He was later advanced to boiler room engineer, testing engineer, efficiency engineer, superintendent of generating stations and assistant chief operating engineer. In January, 1947, he assumed the position of chief operating engineer.

Mr. Grunert's responsibilities included the operation of the Edison company's four Chicago generating stations, having a combined capacity of 1,270,000 kw, and the company's more than 100 substations.

Mr. Grunert is currently chairman of the boiler waters committee of the Utilities Research Commission and chairman of the joint research committee on steam contamination of the EEI and the AEIC. He has also been sub-chairman and active on the power generation committee of AEIC and as a member of ASME.

Makers of *Community*

"stir up" new economies with boiler modernization



The Sherrill, N. Y. plant of Oneida Ltd., manufacturers of Community, Heirloom Sterling, 1881 (R) Rogers (R), and Tudor Plate silverware is another typical example of how boiler modernization pays off. Here, one new B&W Integral-Furnace Boiler replaced two old boilers with these results: steam capacity more than doubled—less floor space occupied—efficiency up—reliability increased—wider variety of coal burned.

Perhaps you can profit by calling on B&W to help you "stir-up" new economies through modernization of your steam-generating facilities.

• *Selection of this 50,000 lb. per hr. stoker-fired B&W Boiler to replace two old units was strongly influenced by 10 years' satisfactory service of another B&W Integral-Furnace unit in the same plant.*

G-420

THE BABCOCK & WILCOX CO.

General Offices: 85 Liberty St., New York 6, N. Y. *Works: Alliance and Barberton, O.; Augusta, Ga.*

FOR POWER PLANTS — B&W, Open-Pass, Radiant, Integral-Furnace, Cross-Drum, Stirling and Waste-Heat Stationary Boilers . . . Air Heaters . . . Economizers . . . Superheaters . . . Water-Cooled Furnaces . . . Oil, Gas & Multifuel Burners . . . Chain-Grate Stokers . . . Stacks and Breechings . . . Seamless & Welded Tubes for All Pressure and Mechanical Applications . . . Refractories . . . Chemical Recovery Units . . . Alloy Castings.

• • •

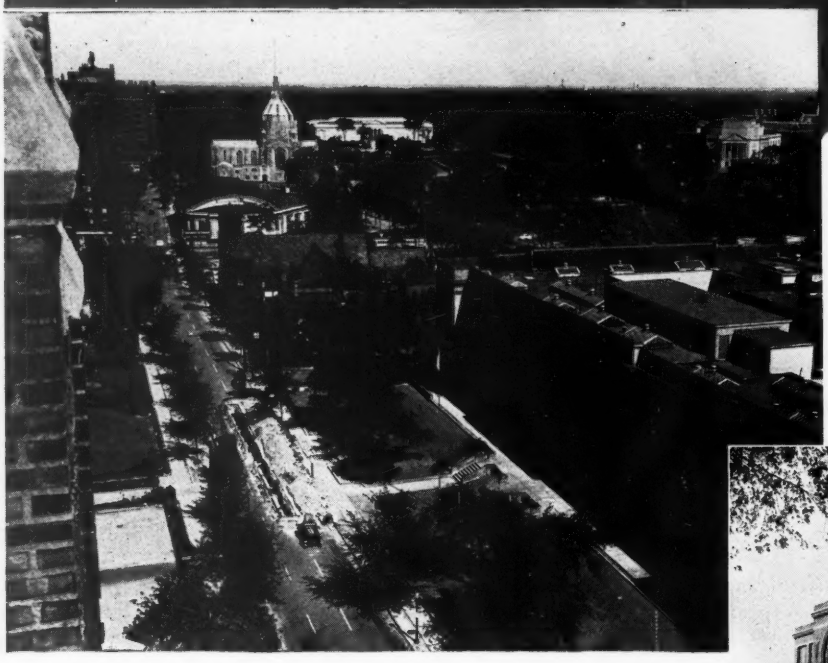
OTHER B&W PRODUCTS — Marine Boilers . . . Pressure Vessels . . . Process Equipment.

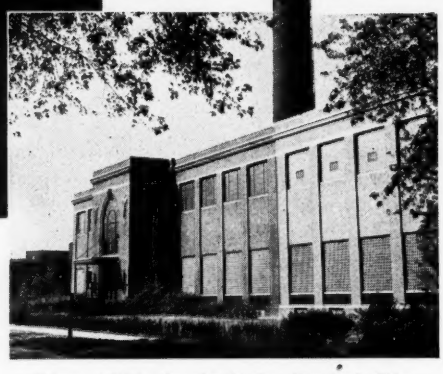
B&W BABCOCK & WILCOX

Municipal Pumping Station puts

EXCESS STEAM TO EXCELLENT USE

in Central Heating System





A partial view of the area served

Fairmount Water Pumping Station, Cleveland, Ohio

THE EUCLID-CARNEGIE-EAST 105th STREET district is Cleveland's second largest commercial community. This area is given over to office buildings, hotels, stores, restaurants, theatres, churches and apartment buildings.

The virtual absence of smoke throughout this forty block area is attributable to the fact that the district enjoys Central Heating. This great asset to the community was made possible by the foresight and efficiency of the city's water department.

This Central Heating system originates at the Fairmount Municipal Pumping Station about a mile away from the heart of the business district served. Instead of wasting exhaust steam after process and plant heating requirements have been met, Fairmount puts its steam to work again. By controlling it and supplementing it with some live steam, the city provides an adequate steam supply for this important community.

Over 237,000,000 pounds of this "ready-made heat in its most convenient form" is delivered annually via Ric-wiL Hel-cor Insulated Pipe Units and Ric-wiL Cast Iron and Tile Conduit Systems to 131 large customers in the area.

For full information on Ric-wiL Insulated Piping for Central Heating and for Industrial Pipe Distribution Systems write The Ric-wiL Co., Dept. 7-H.

No Detour Necessary

Carnegie Avenue carries over 28,000 cars and buses daily. This heavy traffic flow was not disturbed when a Fairmount Steam main in Ric-wiL Hel-cor Insulated Piping was installed under the busy thoroughfare, 21' long Ric-wiL Units through a tunnel formed of 36" diameter Armco Corrugated Steel Pipe, which had been jacked through the ground under the street.

RIC-WIL

INSULATED PIPING SYSTEMS

THE RIC-WIL COMPANY • CLEVELAND, OHIO

REPRESENTATIVES IN PRINCIPAL CITIES

BASIC LINES OF DEFENSE IN BOILER WATER CONDITIONING

2nd

THE SECOND LINE OF DEFENSE IS ADJUSTMENT OF INTERNAL TREATMENT

The adjustment of internal treatment of boiler water to maintain proper chemical balances is based on many considerations—

- Chemical analysis of make-up water, condensate, and feedwater
- Boiler operating pressure and rating
- Ultimate purpose of the steam
- Types of pumps, heaters, economizers, etc., to be used
- Past difficulties requiring special considerations

Treatment must provide proper alkalinity adjustment and hardness reduction. Oxygen scavengers must be considered if deaeration is not complete.

These are just a few of the many considerations which your local Dearborn Engineer is qualified to advise you about, to establish proper chemical balances in your boilers through a plant survey and laboratory analytical data. For complete water conditioning, he is your consultant for all five basic lines of defense.

THE 5 BASIC LINES OF DEFENSE

1. **Adjustment of pretreatment**
2. **Adjustment of internal treatment**
3. **Proper means for treatment application**
4. **Blowdown adjustment**
5. **Test control**

Dearborn
Reg. U. S. Pat. Off.

THE LEADER IN BOILER WATER TREATMENT AND RUST PREVENTIVES

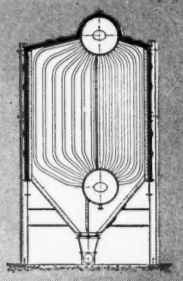
DEARBORN CHEMICAL COMPANY

310 S. Michigan Ave., Chicago 4 • 807-15 Mateo St., Los Angeles
205 E. 42nd St., New York • 2454 Dundas St., West, Toronto

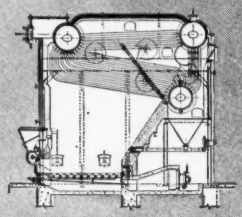
WICKES

STEAM GENERATORS FOR ALL INDUSTRY

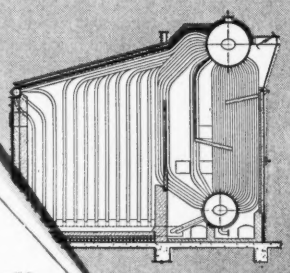
Wickes Steam Generators are in constant daily service in thousands of installations throughout the world. Wickes can fill your exact requirements for boilers of any type up to 250,000 lbs. steam per hour and 850 psi. • Wickes Boilers are engineered for use in oil, chemical, paper and many other industrial uses. Our knowledge of steam generation is available for your consultation, without obligation. Descriptive literature available upon request.



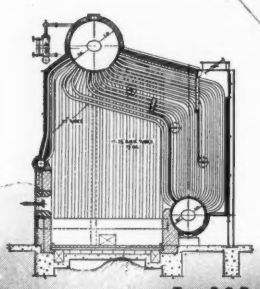
Wickes 2 Drum Waste Heat Installation



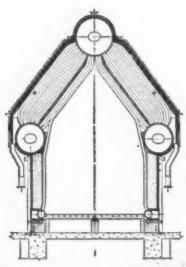
3 Drum Low Head Water Tube Boiler



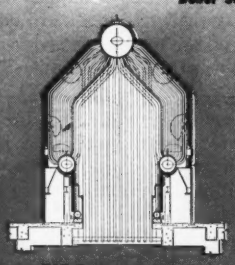
2 Drum Water Tube Boiler



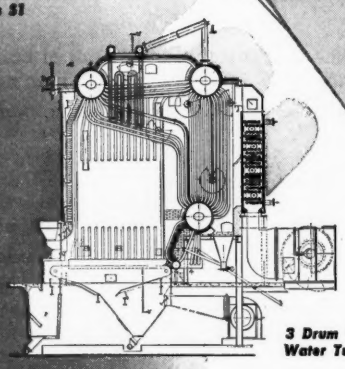
Type-S 2 Drum Boiler Series 51



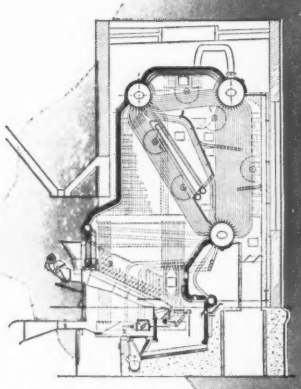
"A" Type Water Tube Boiler



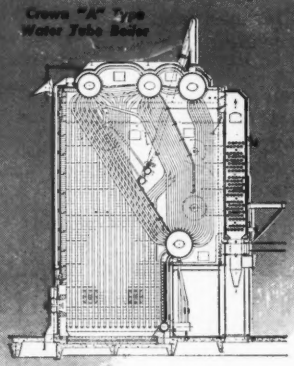
Crown "A" Type Water Tube Boiler



3 Drum "B" Type Water Tube Boiler



3 Drum Water Tube Boiler



4 Drum Water Tube Boiler

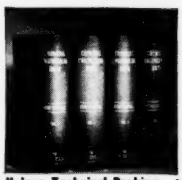
THE WICKES BOILER CO.

SAGINAW, MICHIGAN

SALES OFFICES: Atlanta • Boston • Charlotte, N.C. • Chicago Cincinnati • Denver • Detroit • Houston • Indianapolis • Kansas City • Los Angeles • Milwaukee • New York City • Pittsburgh San Francisco • San Jose • Seattle • St. Louis • Tulsa • Saginaw Mexico City • Buenos Aires.

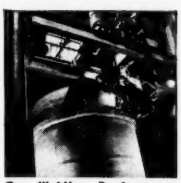
DIVISION OF THE WICKES CORPORATION • RECOGNIZED QUALITY SINCE 1854

Metallurgical Research conducted continually by recognized specialists who have made major contributions in this field.



Unique Technical Backing of an extensive organization with an international reputation in both process and fabrication engineering.

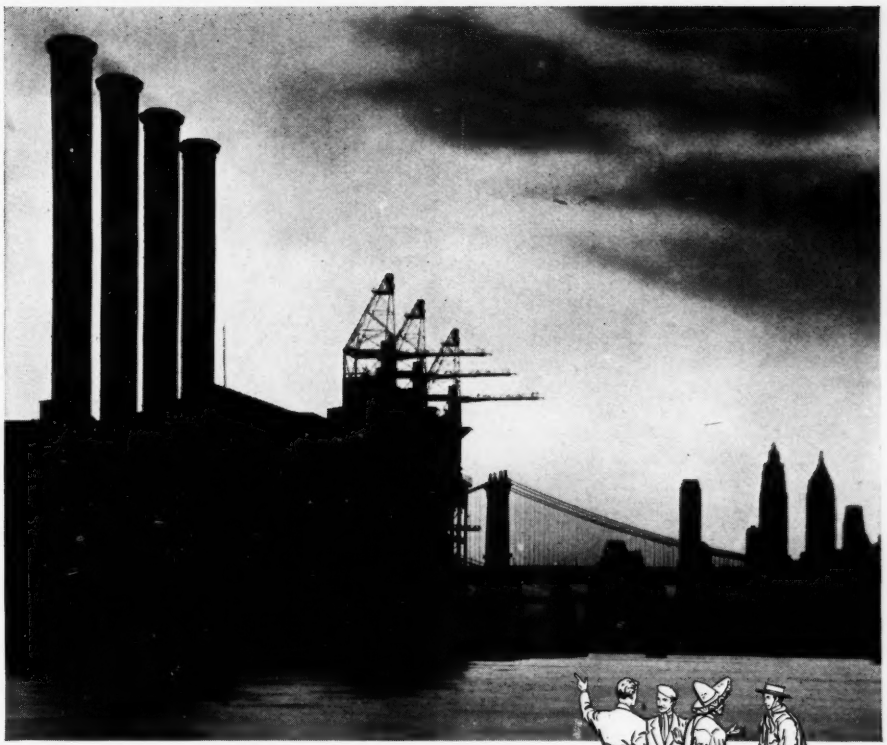
Complete Facilities for the fabrication of steel products from simple forgings to the most intricate 120 foot towers.



Top Welding Performance assured by specially designed equipment and exclusive employment of master operators.

Quality Control embracing the constant application of the most advanced inspection methods, both visual and non-destructive.

On-Time Delivery made possible by a flexible planning group authorized to re-route work to meet promised dates.



What José tells Joe

WORD certainly gets around.

Kellogg's only fabricating shop for high pressure and high temperature piping is in Jersey City. Yet orders for power piping continue to come not only from the logical sales areas but also from Europe, Central America, South America and from half a dozen different geographical centers in the U. S. A.

Why? The answer we like to believe is that the word gets around that Kellogg installations leave no undesirable after-taste, that, to use a prosaic phrase, they leave only satisfied customers. And they should, because "built into" each installation are certain factors that virtually guarantee better than average performance and service life.

For example, there's extensive "creep-testing" of high temperature materials being conducted in Kellogg's metallurgical Laboratory. And there's the concurrent, continuous study of *graphitization.*

There's the exclusive apparatus for the *determination of stresses* in complicated piping installations. There are the *shop fabricating techniques* and *shop quality check system* that are considered among the best in industry.

There are the *field installation methods* that were nurtured on penstocks and matured on the field construction of more than half of the world's refinery cracking capacity.

And beyond these, there are *more than thirty years* of successful completion of the highest temperature and highest pressure power piping – including installations in some of the world's largest power plants.

These are the reasons why the word about M. W. Kellogg power piping gets around when José talks to Joe, or whenever and wherever in the world power men meet.

To master temperature, pressure and chemicals use

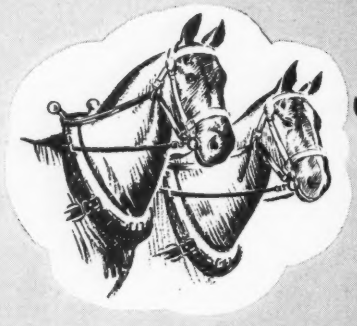
M. W. KELLOGG

process equipment

VESSELS • EXCHANGERS • CONDENSERS • HIGH PRESSURE AND HIGH TEMPERATURE POWER PIPING
PROCESS PIPING • FORGED AND WELDED FITTINGS . . . IN ALL STEELS, ALLOYS OR SPECIAL COMBINATIONS

The M. W. Kellogg Company, Inc. (A Subsidiary of Pullman, Inc.) – Offices in New York, Jersey City, Buffalo, Los Angeles, Tulsa, Houston, Toronto, London and Paris.

EVERLASTING
Boiler Blow-off Valves...
teamed up for "EVERLASTING" service



4011/6561-Unit; angle blowing valve with wheel-operated sealing valve.

4001/4061 Unit; straightway blowing valve with lever-operated sealing valve.

The unique service qualities of EVERLASTING Blow-off Valves have long been demonstrated in boiler-rooms throughout the country. Now their superior design features have been teamed up in these new EVERLASTING Duplex Blow-off Units. And either unit far exceeds your demands for reliable service in blowing down your boilers.

HERE'S WHAT YOU GET WITH THESE NEW DUPLEX UNITS

Sealing Valve of Either Team Provides (shown on left of units)

- Lever- or wheel-operated types — as you desire
- Unrestricted flow — straight-through
- Rotating sliding disc — self-grinding, self-lapping
- Drop-tight seal — improving with use
- Non-wedge action — no sticking, no jamming

Blowing Valve of Either Team Provides (shown on right of units)

- Straight-way or angle types to select from
- Strength to withstand repeated shock of blow-off force
- Exceptional resistance to erosion, abrasion and rust
- No pockets to permit lodgment of solids
- Positive action, self-cleaning

Not only do these EVERLASTING Duplex Blow-off Units provide an absolutely drop-tight seal — they are so constructed that long and repeated operation will not affect this tightness. Other Duplex Units for varied requirements are shown in our Bulletin.

Either valve of any EVERLASTING Duplex Unit can be supplied separately. But for boiler blow-off applications, any one of the complete EVERLASTING Duplex Units assures *absolute safety — at low maintenance cost.*

Ask your distributor — or write directly to us — for complete information.

EVERLASTING VALVE COMPANY
49 Fisk Street, Jersey City 5, N. J.

Trade-mark "EVERLASTING"—REG. U. S. PAT. OFF.

EV-328

EVERLASTING VALVES *GIVE "EVERLASTING" SERVICE!*

STANDARD OIL COMPANY (INDIANA) Power Plant, serving a refinery at Wood River, Illinois. Built during World War II, it is one of a number of large-scale facilities constructed by Dravo to satisfy the varied power needs of many diverse industries.

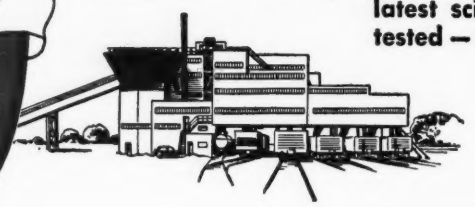
DRAVO
CORPORATION
DRAVO BUILDING, PITTSBURGH 22, PA.

Engineering Constructors of power plants, boiler plants, central stations, compressor stations, water pumping stations—fabricators and erectors of power piping—power and boiler plant equipment.

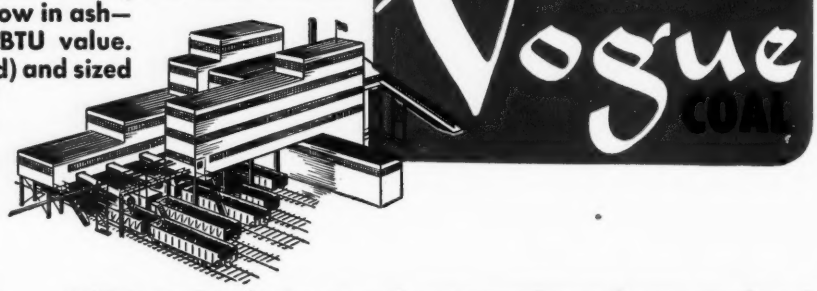
PITTSBURGH · PHILADELPHIA · CLEVELAND · NEW YORK · DETROIT

First Choice of Industry
because of Improved Preparation!

OLD ABE Coal . . . from one of America's newest and largest producing mines . . . is a superb stoker and industrial coal that is performance-proved for its clean, free-burning qualities. Expertly prepared by the most modern methods known to the industry, in a new preparation plant fully equipped with the latest scientific machinery. Laboratory tested — thoroughly washed — sized to your needs — oil treated (if desired).



VOGUE Coal is another of Southern's ultra-modern quality coals, that is specially processed in a great, new streamlined preparation plant. It's low in ash—free-burning—and high in BTU value. Washed, oil treated (if desired) and sized to a maximum degree of uniformity for ideal stoker and industrial use.



SKIBO Coal is the latest and most popular coal ever marketed by the producer during 50 years of successful operation. It meets industry's demands for quality and unvarying efficiency. Skilled mining engineers and laboratory technicians assure uniform production day after day. Thoroughly cleaned in one of the most modern washers obtainable — oil treated (if desired), uniformly sized. Low in ash — high in BTU value.

These three great premium industrial coals from Western Kentucky are ready for immediate shipment. Tremendous production and extensive reserves assure dependable delivery for years to come.

Southern's 53 years of experience and staff of Combustion Engineers are ready to help you solve your particular boiler room problems. Telephone, write or wire and a Southern representative will call.

SPONSORING MEMBER COAL HEATING SERVICE NATIONAL COAL ASSOCIATION

SOUTHERN COAL COMPANY INC.

AVS-2

Southern Coal Company, Inc.

Atlanta Birmingham Charlotte Chicago Knoxville
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In Canada — Boon-Strachan Coal Co., Ltd., Montreal

*POUR POINT

Today, it is essential to use the best lubricants money can buy — for maximum efficiency . . . lowest operating cost. That's why more and more production machinery is being lubricated with Tycol oils and greases.

Whatever your lubricating need — for turbine, steam engine, mine car or tipple, textile mill, stationary Diesel or locomotive — there's a Tycol high quality oil or grease exactly suited to your specific need.

In developing this comprehensive line, Tycol subjects each individual oil and grease to rigid tests during manufacture. This control assures the required lubrication characteristics — *POUR POINT, viscosity, color, penetration, to name a few — for maximum performance of that particular product.

Let us show you the extra value in every measure of Tycol oil and grease. Write your nearest Tide Water Associated office today.

TYCOL
INDUSTRIAL LUBRICANTS

Boston • Charlotte, N. C. • Pittsburgh • Philadelphia • Chicago Detroit • Tulsa • Cleveland San Francisco • Toronto, Canada

TIDE WATER ASSOCIATED OIL COMPANY
17 BATTERY PLACE - NEW YORK 4, N.Y.

***LEARN WHAT THIS PRODUCT CHARACTERISTIC MEANS TO YOU — READ "LUBRICANIA"**

This informative handbook, "Tide Water Associated Lubricania," gives clear, concise descriptions of the basic tests used to determine important properties of oils and greases. For your free copy, write to Tide Water Associated Oil Company, 17 Battery Place, New York 4, N. Y.

REFINERS AND MARKETERS OF VEEDOL — THE WORLD'S MOST FAMOUS MOTOR OIL

Creator of profits — not consumer — is maintenance that steps up availability and betters performance of steam generating equipment.

Whether metal serves wet or dry, under high heat or cold, there's a Dampney surfacing material to guard against ills that threaten steel . . . to hold power-producing equipment to full-life peak efficiency.

These benefits are being enjoyed today in plants where Dampney coatings were first introduced more than thirty years ago. Yours to call upon freely is the experience thus gained in long association with steel that serves power.

For general information, ask for product bulletins 1500, 1530 and 1540.

DAMPNEY Maintenance for Metal

THE DAMPNEY COMPANY of AMERICA • Hyde Park, Boston 36, Mass.

COMING EVENTS

ASME—1949 Semi-Annual Meeting of The American Society of Mechanical Engineers to be held at the University of California, University Extension Building, San Francisco, June 27 to July 1.

ASME—15th National Applied Mechanics Division Conference of The American Society of Mechanical Engineers to be held at the University of Michigan, Ann Arbor, June 13-15.

ASEE—The 1949 Convention of the American Society for Engineering Education will be held at Rensselaer Polytechnic Institute, Troy, N. Y., June 20-24.

AIEE—1949 Meeting of the American Society of Electrical Engineers, Summer General Meeting, Swampscott, Mass., New Ocean House, June 20-24; Pacific General Meeting, San Francisco, Fairmont Hotel, August 23-26; Midwest General Meeting, Cincinnati, Netherland Plaza Hotel, October 17-21.

ASTM—The 52nd Annual Meeting of the American Society for Testing Materials to be held at the Chalfonte-Haddon Hall, Atlantic City, June 27 to July 1.

ISA—The Fourth National Instrument Exhibit to be held at the St. Louis Municipal Auditorium, St. Louis, Sept. 12-16.

NACE—A meeting of the South Central Section, National Association of Corrosion Engineers, will be held at the Adolphus Hotel, Dallas, Texas, October 3 and 4.

ASTM—The First National Meeting of the American Society for Testing Materials to be held on the West Coast will be held at the Fairmount Hotel, San Francisco, October 10-14.

ASCE—1949 Meeting of the American Society of Civil Engineers, Summer Convention, Mexico City, July 13-15; Fall Meeting, Washington, D. C., November 2-4.

Midwest Power Show—The 9th Midwest Engineering and Power Exposition will be held at Navy Pier, Chicago, November 11-16.

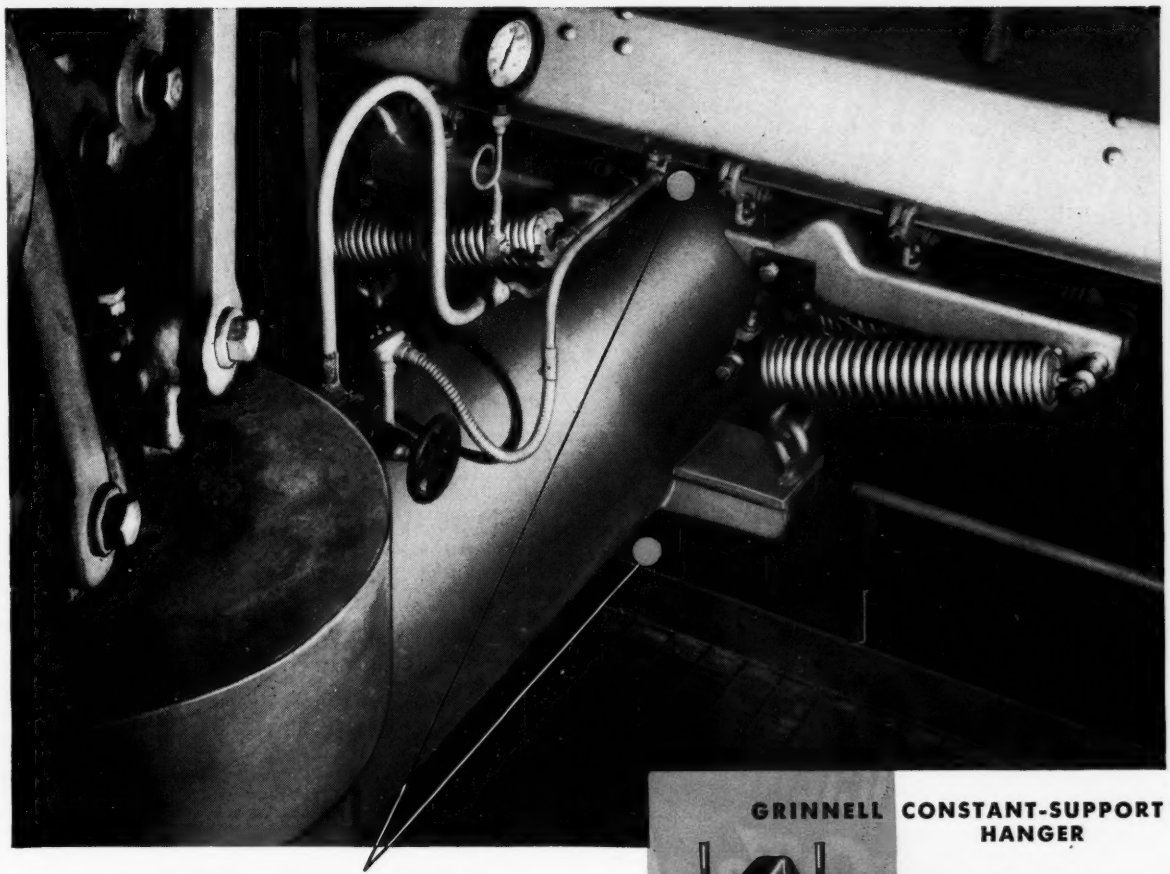
Obituaries

C. NEAL BARNEY vice president, secretary and general counsel of Worthington Pump and Machinery Corp., passed away at his home in Scarsdale, N. Y., Sunday, April 24, at the age of 73 years.

He was a native of Lynn, Mass., graduated from Tufts College in 1895; took his law degree at Boston University and then returned to Tufts for further post-graduate study. Later he was a lecturer at the law schools of both Northeastern and Boston Universities. He was chairman of the legal advisory committee for the draft board in Lynn during World War I. He was also a trustee for Tufts from 1909 to 1921.

Mr. Barney joined Worthington as chief counsel and secretary in 1918; was appointed secretary-treasurer in 1932; and was elected vice president and secretary in 1942.

At the time of his death, Mr. Barney was president of the Maria Mitchell Association, Nantucket, and was a member of Theta Delta Chi, Phi Beta Kappa, the Society of Mayflower Descendants, the Newcomen Society, the Pacific Club, the University Club and the Massachusetts, New York State, and American Bar Associations.



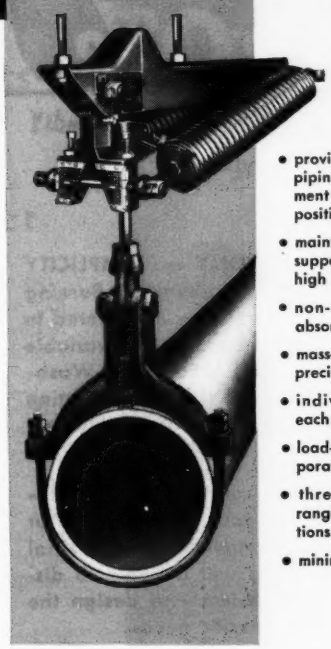
PLAYROOM for a HEAVYWEIGHT

It's a lively chunk of deadweight, this big boiler lead from a superheater outlet at the stop and check valve . . . in the new Southwark station of the Philadelphia Electric Company. It requires "playroom". From its position when cold to its position at 900°F., this piping travels through all three planes — vertical, lateral and longitudinal.

At every point of its travel, the weight of this piping is fully supported by Grinnell Constant-Support Hangers. Yet, because of their compact design, little extra "playroom" need be allowed in which to install the hangers.

Write for the new Grinnell Pipe Hanger Catalog 10-D, containing every pipe hanger, part and accessory, with full instructions for easy selection and correct specification.

GRINNELL CONSTANT-SUPPORT HANGER



the ONLY constant-support pipe hanger

- provides constant support to piping subject to vertical movement—in all "hot" and "cold" positions.
- maintains full safety factor in supporting high temperature, high pressure piping.
- non-resonant and energy absorbing.
- mass-produced from standard precision parts.
- individually calibrated for each installation.
- load-adjustment features incorporated into design.
- three models meet entire range of load-travel specifications.
- minimum headroom required.

99 YEARS PIPING

GRINNELL

Grinnell Company, Inc., Providence, R. I. Branch warehouses: Atlanta • Buffalo • Charlotte • Chicago • Cleveland • Cranston • Fresno • Kansas City • Houston Long Beach • Los Angeles • Milwaukee • Minneapolis • New York • Oakland • Philadelphia • Sacramento • St. Louis • St. Paul • San Francisco • Seattle • Spokane

AN
ANTHONY
OIL BURNING
SYSTEM

AVERAGE OVERALL
EFFICIENCY
80%

In a Large Washington, D. C., Laundry

For EFFICIENCY, ECONOMY and SIMPLICITY of operation install an Anthony Oil Burning System. Anthony Systems are engineered to your job . . . designed to meet the variable conditions of each installation. This Washington, D. C. laundry is steadily operating at an average overall evaporating efficiency of better than 80%.

Are you interested in cutting fuel consumption and increasing heating efficiency? Our engineers, widely experienced in Industrial Heat Treating Systems will be glad to discuss your heating problem and design the apparatus for your specific needs.

The ANTHONY COMPANY
47-33 FIFTH STREET
LONG ISLAND CITY 1, N. Y.
Representatives in Principal Cities

POWER PLANT Construction News

Wallingford, Conn.—Borough Electric Works, Wallingford, has plans maturing for new steam-electric generating station on North Washington St., reported to cost about $3,500,000, with turbine-generator, high-pressure boiler and auxiliary equipment. Burns & McDonnell Engineering Co., 95th and Troost Sts., Kansas City, Mo., is consulting engineer.

New Bedford, Mass.—New Bedford Gas & Edison Light Co., 693 Purchase St., has approved plans for new multistory addition to local steam-electric generating station on Cannon St., about 55x100 ft, and work will proceed at once. Additional equipment will be installed for increased capacity. Cost estimated close to $2,750,000. Gilbert Associates, Inc., 412 Washington St., Reading, Pa., is consulting engineer.

Detroit, Mich.—Murray Corp. of America, Inc., 7700 Russell St., steel automobile bodies, has engaged Boddy-Benjamin Associates, 2210 Park Ave., Detroit, consulting engineers, to make surveys and estimates of cost for new power house at plant.

Fergus Falls, Minn.—Otter Tail Power Co., Fergus Falls, has plans for new generating station at Hoot Lake, near Fergus Falls, supplementing present power plants in that area. It will be equipped for an initial rating of 15,000-kw, and is estimated to cost approximately $3,000,000. Work will be carried out soon.

Lincoln, Neb.—State Board of Control, State Capitol Building, plans new power house at local State Hospital. Installation will include a turbine-generator unit, boiler and accessory equipment. Proposed to carry out work during summer. No estimate of cost announced. Fritz Craig, First National Bank Bldg., Lincoln, is architect.

Newburgh, N. Y.—Central Hudson Gas & Electric Co., Poughkeepsie, N. Y., has preliminary plans in progress for new steam-electric generating plant at Dannskammer Point, near Newburgh, with frontage on Hudson River. It will be equipped for an initial rating of 50,000-kw and is reported to cost approximately $5,000,000.

Franklin, N. C.—Nantahala Power & Light Co., Franklin, plans series of four new hydroelectric interconnected power plants on East Fork of Tuckasegee River, Jackson County, Tenn. Sites have been selected. Application has been made to Federal Power Commission, Washington, D. C., for permission to carry out project.

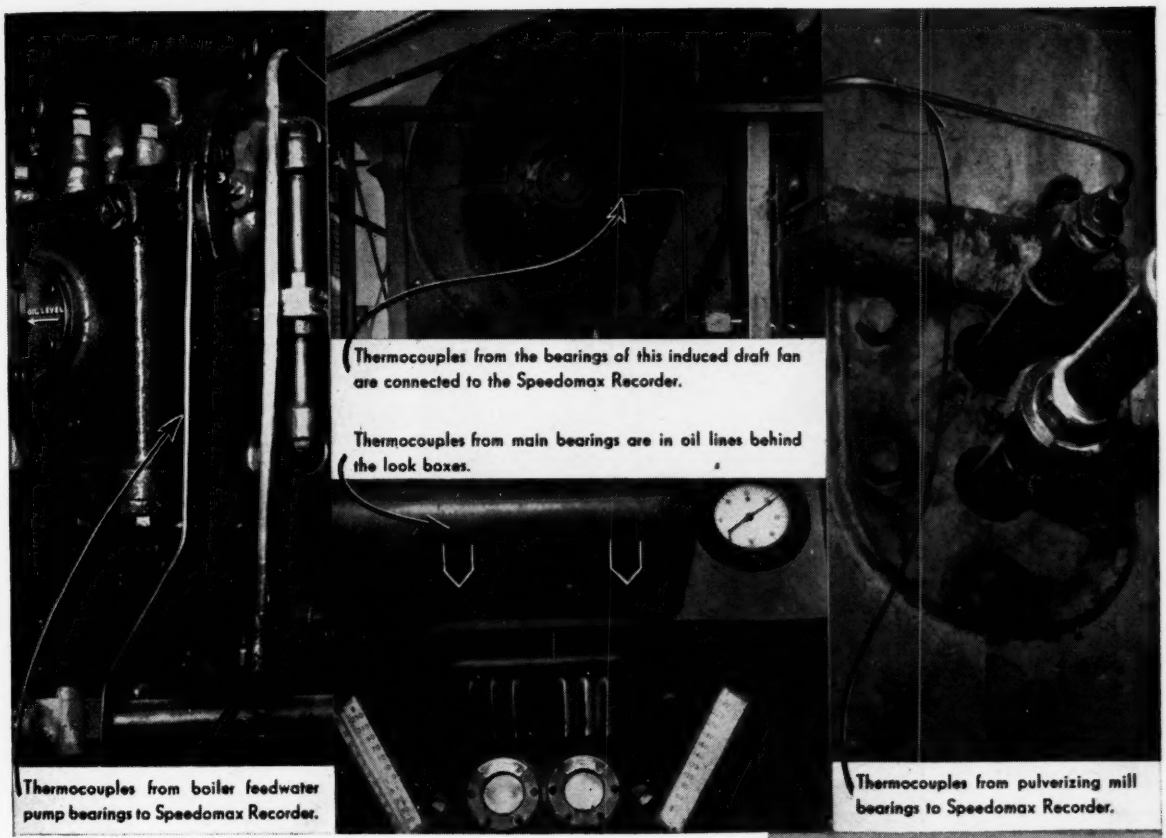
Cleveland, Ohio—Cleveland Electric Illuminating Co., 75 Public Sq., has authorized fund of approximately $87,500,000, for expansion and improvements in power plants and system over a period of months. Program will include a new generating station in vicinity of Willoughby, Ohio, where tract of 45 acres of land recently was acquired, estimated to cost about $20,000,000 of total sum noted. Construction is scheduled to be placed under way soon.

New Richmond, Ohio—Cincinnati Gas & Electric Co., 4th and Main Sts., Cincinnati, Ohio, has plans maturing for new steam-electric generating station at New Richmond, vicinity of Cincinnati, reported to cost about $6,000,000. Sargent & Lundy, 140 South Dearborn St., Chicago, Ill., are consulting engineers.

Medford, Ore.—California-Oregon Power Co., Medford, plans a group of eight interconnected hydroelectric generating statjons on North Umpqua River, all situated in same license area, with gross rating of 145,000-kw, estimated to represent a total investment of about $50,000,000, including transmission lines, power substations, switching stations and other operating facilities. Project is scheduled to be carried out in a period of 60 months.

Kollock, S. C.—J. P. Stevens & Co., Inc., 44 Leonard St., New York, N. Y., cotton and rayon goods, plans boiler house at proposed new fabric-finishing mill at Kollock, where tract of land has been acquired. Main plant will approximate 100,000 sq ft floor space. A pumping station will be built. Entire project is reported to cost in excess of $2,000,000. J. E. Sirrine Co., Main St., Greenville, S. C., is architect and engineer.

Richmond, Va.—Hinde & Dauch Paper Co., Petersburg Pike and Hopkins Rd., corrugated boxes and containers, will build a boiler house at new converting plant on Petersburg Pike, previously noted in these columns. Main factory will be 310 x 428 ft. Entire project will represent a reported investment in excess of $1,000,000. Work on superstructure will begin soon. Carneal & Johnson, Atlantic Life Bldg., Richmond, are architects. Main offices of company are at Sandusky, O.


Thermocouples from the bearings of this induced draft fan are connected to the Speedomax Recorder.
Thermocouples from main bearings are in oil lines behind the look boxes.
Thermocouples from boiler feedwater pump bearings to Speedomax Recorder.
Thermocouples from pulverizing mill bearings to Speedomax Recorder.

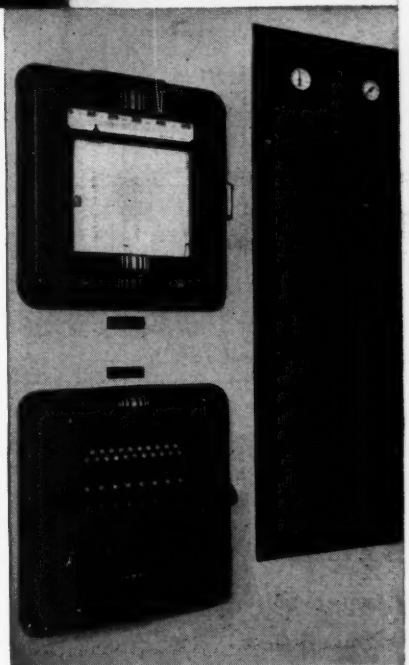
Temperature From These 4 Points . . . and 156 more . . . At ONE Speedomax Recorder

Remarkably fast, this new Speedomax offers a definite advance in temperature checking and recording. With Speedomax, an operator can "tour" the temperatures of 160 points in a little less than eleven minutes. He can watch readings as they are automatically indicated; or Speedomax will record them for later examination and for the shift log.

Readings are supplied in such rapid rotation, that it is generally possible to spot any high or low temperature as soon as it develops. In addition, greater operating efficiency is obtained because of the centralization of instrument readings.

The installation procedure is entirely standard. The company's staff simply installs thermocouples at those points from which they desire temperature readings. Couples are connected to the Speedomax equipment in banks of 20 each, with as many as eight banks. Appropriate alarms may be included.

For further information about this versatile temperature checking equipment, simply write for your copy of Folder ND46-33A(1). Address Leeds & Northrup Co., 4973 Stenton Ave., Philadelphia 44, Penna.



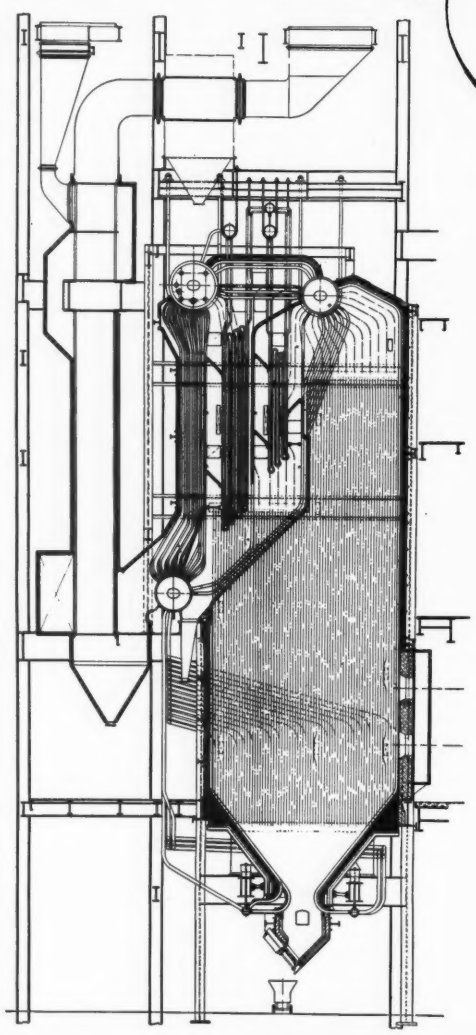
Speedomax Recorder for all points shown and enough more to record a total of 160.

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

LEEDS & NORTHRUP CO.

Irl Ad ND46-33A(2)

350,000
POUNDS OF STEAM PER HOUR



Purchaser—
Minnesota Power & Light Co.

Location—
Duluth, Minn.

Number of Boilers.....1

Type of Boiler
Erie City 3-Drum
Steam Generator

Pounds of Steam/Hr. 350,000

Design Pressure....1025 PSI

Operating Pressure . 925 PSI

Steam Temperature.. 905° F.

Water Walls.....Erie City
Bare Tube

Air Heater.....Erie City
Tubular

STEAM POWER PLANT EQUIPMENT

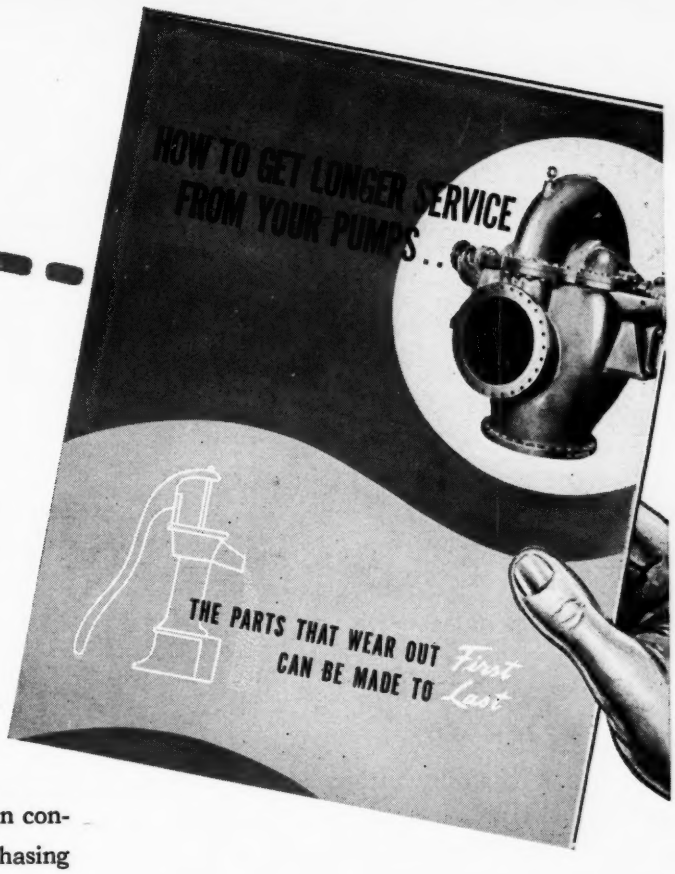
Complete Steam Generators • Type C 3-Drum Boilers • Type VL 2-Drum Boilers • The "Economic" Boiler with or without Water Walls • Welded H. R. T. Boilers • Welded Steel Heating Boilers • Coal Pulverizers • Underfeed Stokers • Welded Pressure Vessels for the Process Industries.

ERIE CITY
SINCE 1840

ERIE CITY IRON WORKS • ERIE, PA.

FREE...

VALUABLE INFORMATION FOR PUMP USERS



Here is a new booklet, just off the press, that belongs in the files of every man concerned with operating, maintaining, or purchasing pumping equipment.

Case histories drawn from important industrial fields, show how pump operators and manufacturers have successfully dealt with those long-time enemies of pump life—corrosion, fatigue, and excessive wear.

You'll find these stories well worth reading . . . and they may suggest a solution to your own pump problems.

Meanwhile, if you are looking for ways to improve your pump installations, or are contemplating buying new ones, here is a tip worth remembering:

Most pump users agree that pump parts last longer when they're made of *Monel**, *"K"* Monel, or "S"* Monel.* And that's not surprising, for these Inco Nickel Alloys have strength and fatigue resistance equal to that of structural steel. They are rustproof, hard, and corrosion-resistant as well.

These Inco "task" Alloys bring you other important advantages, too. For a more complete discussion of their desirable physical properties in pump applications, send for the new booklet . . . today.

Just mail the coupon. *Reg. U. S. Pat. Off.

EMBLEM OF SERVICE INCO TRADE MARK

***Monel*... for minimum maintenance**

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 WALL STREET, NEW YORK 5, N. Y.

Please send me your new booklet: *"How to Get Longer Service from Your Pumps."*

NAME.....

TITLE.....

PG 6-49

COMPANY.....

.....

.....

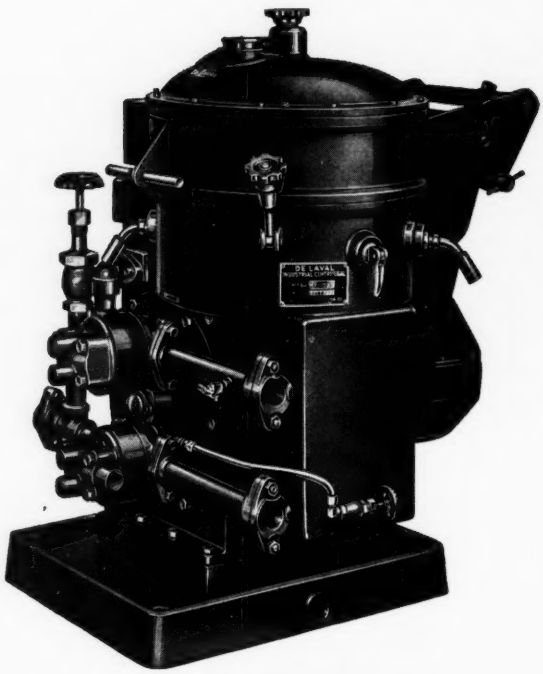
I PROTECT YOUR TURBINE • • BY REMOVING DIRT AND WATER

"My name is De Laval Centrifugal Force. I keep lubricating oil—either turbine lube or Diesel lube—both ***clean*** and ***dry***.

"It's an advantage to the operator to be able to remove ***both*** contaminants the way I do. It means he never has to worry about either dirt ***or*** condensate in his oil when I am on the job. Sometimes I have to remove a sudden and dangerous 'slug' of water; sometimes I just keep the oil dry by continuous removal of relatively little condensate.

"And, of course, my centrifugal force will instantly throw out from the oil every solid impurity so that the oil will be clean and dehydrated.

"My services for protecting a turbine cost only a small fraction of the cost of the original equipment, and far less than even ***one*** serious 'down' incident."

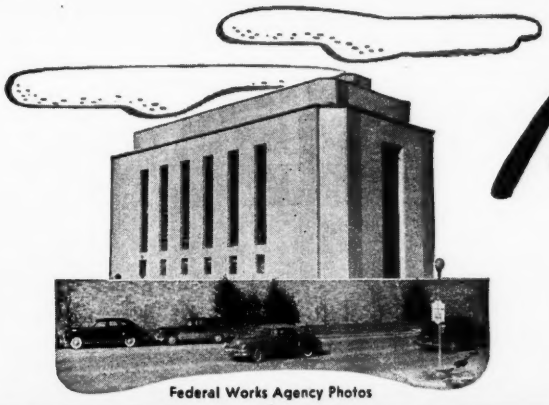


De Laval No. 67 "Uni-Matic" Oil Purifier. De Laval Oil Purifiers are furnished in a wide range of capacities.

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

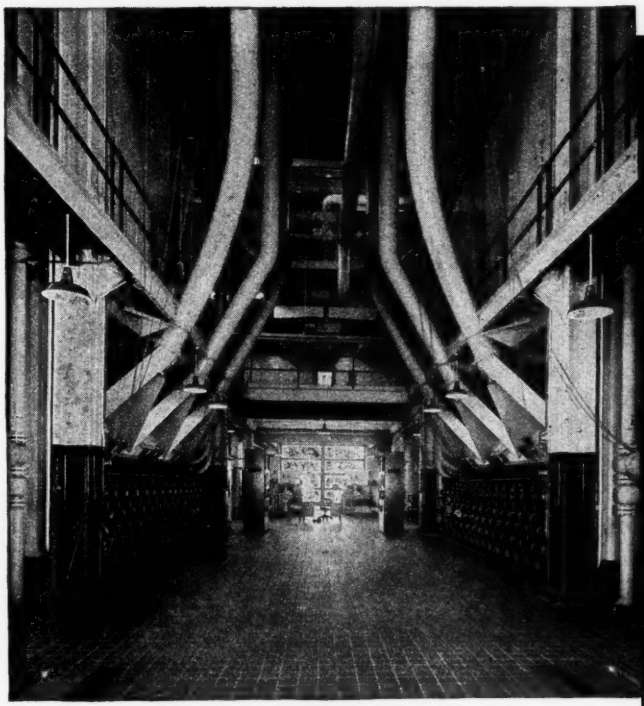
De Laval

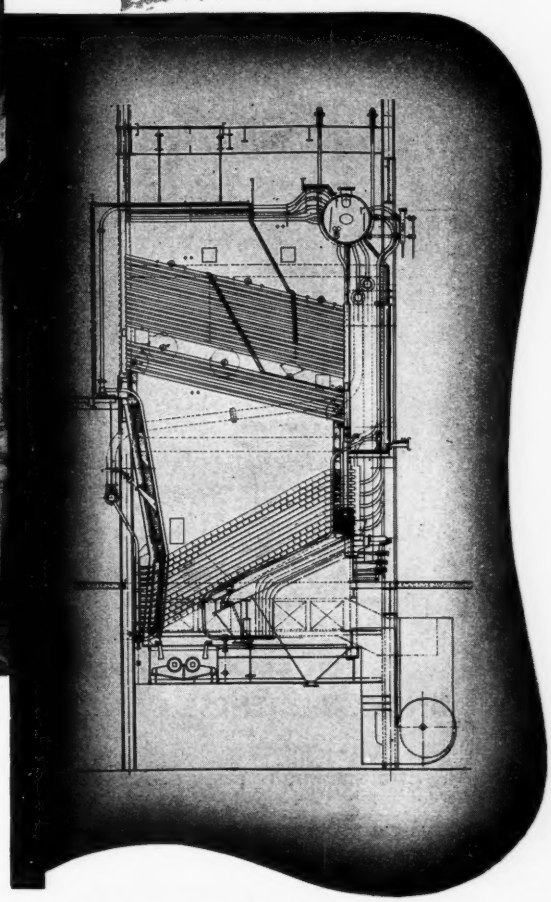
OIL PURIFIERS *for more dependable power production*



Federal Works Agency Photos

More Heat for the NATION'S CAPITAL





New $8,000,000
West Central Heating Plant
Washington, D. C.

Served By

Vogt FORGED STEEL SECTIONAL HEADER

STEAM GENERATORS

ADDITIONAL ORDER NOW BEING FABRICATED FOR THIS PLANT

•

Principal Data, Each Unit

220,000 pounds steam per hour capacity
Steam and water drum is fusion welded and designed for 400 pounds S.W.P.
Sinuous forged steel tube headers. Water cooled furnace walls.

HENRY VOGT MACHINE CO.
Louisville 10, Kentucky

BRANCH OFFICES:
New York • Philadelphia • Cleveland
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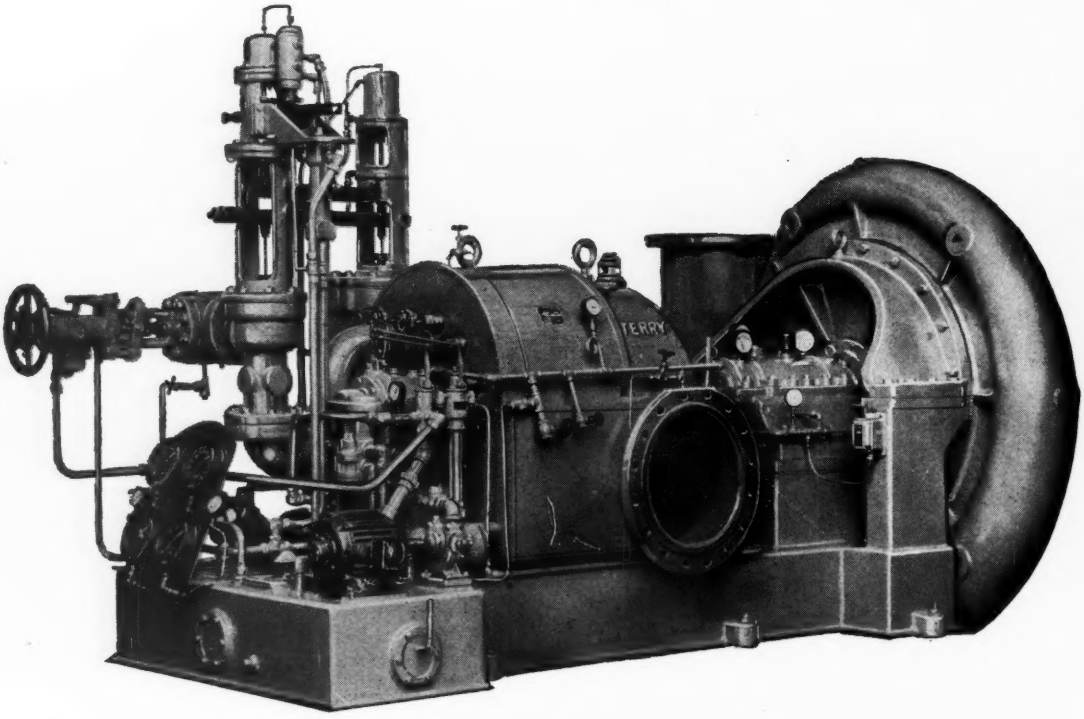
The TERRY TURBINE



SPECIAL PURPOSE TURBINE

FOR OPERATION UNDER ALL THESE CONDITIONS:

1. Straight, high-pressure, condensing
2. Straight, low-pressure, condensing — putting to work excess low-pressure steam.
3. Mixed pressure — using the low-pressure steam available, with only enough high-pressure steam required to drive the compressor
4. Condensing bleeder operation — providing clean, low-pressure steam for heating or process work

. . . and the speed under any of these conditions can be varied from 2800 to 4750 rpm.

This is but one example of many unusual combinations developed by Terry to meet out-of-the-ordinary requirements in turbines up to 2000 hp. Information on a special-purpose turbine for your specific requirements will be gladly furnished.

T1177

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

SPECIFY ERNST WATER COLUMNS AND GAGES FOR ALL PRESSURES AND TEMPERATURES

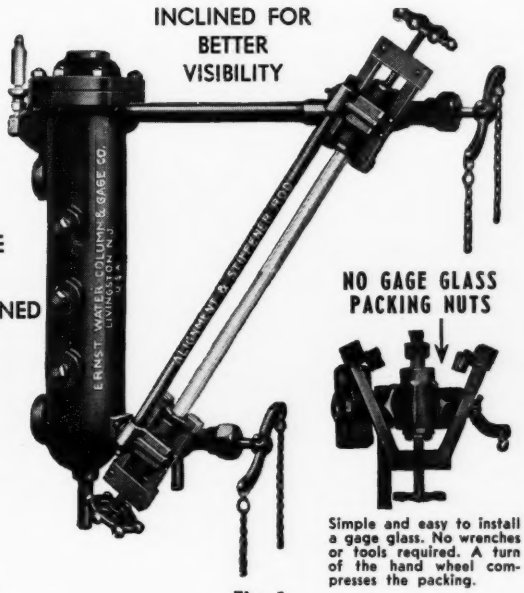
STANDARD STOCK COLUMNS ILLUSTRATED

— OTHER COLUMNS TO SPECIFICATIONS —

GAGES MAY BE SET VERTICAL or INCLINED

Fig. 2

High and Low Alarm Column equipped with Split-Gland Type Adjustable Vertical Water Gage.



INCLINED FOR BETTER VISIBILITY

Fig. 1.

High and Low Alarm Column equipped with Split-Gland Type Adjustable Inclined Water Gage.

NO GAGE GLASS PACKING NUTS

Simple and easy to install a gage glass. No wrenches or tools required. A turn of the hand wheel compresses the packing.

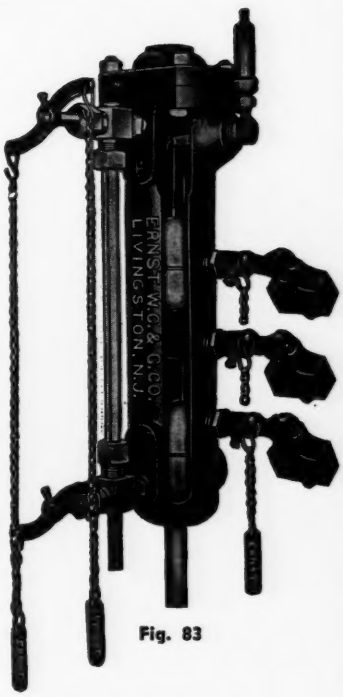


Fig. 83

No. 5 High and Low Alarm Column with Vertical Gages and DCP Weighted Type Try Cocks.

GAGE GLASSES—Tubular & Flat Type

High Pressure Composition Rubber Washers

ALL SIZES

Std. Pattern Fig. 22

Fig. 21 Lip-Mold Pattern

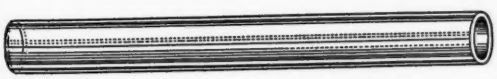


Fig. 12—Master standard clear type (up to 500 lb.)

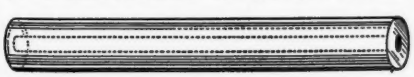


Fig. 23X—Master clear and red line extra strong (up to 1000 lb.)

Fig. 14—Master standard red line (up to 500 lb.)

reflex type B

plain type A

Ernst Master gage glasses are noted for high resistance to pressure and temperature strains, clouding and corrosion.

Sizes—Lengths from 1 to 144 in. Outside diameters—3/8", 1/2", 5/8", 3/4", 7/8", 1", 1 1/8", 1 1/4" and 1 1/2".

GAGE GLASS GUARDS and ILLUMINATORS

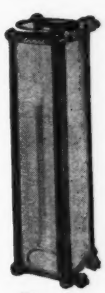


Fig. 31

GUARD AGAINST ACCIDENTS BY SPECIFYING ERNST PLASTIC SAFETY GUARDS

NON-BREAKABLE

IMPROVE YOUR VISION WITH "PLAIN SIGHT" NON-GLARE ILLUMINATORS

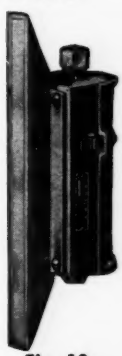


Fig. 10

OTHER ERNST SPECIALTIES

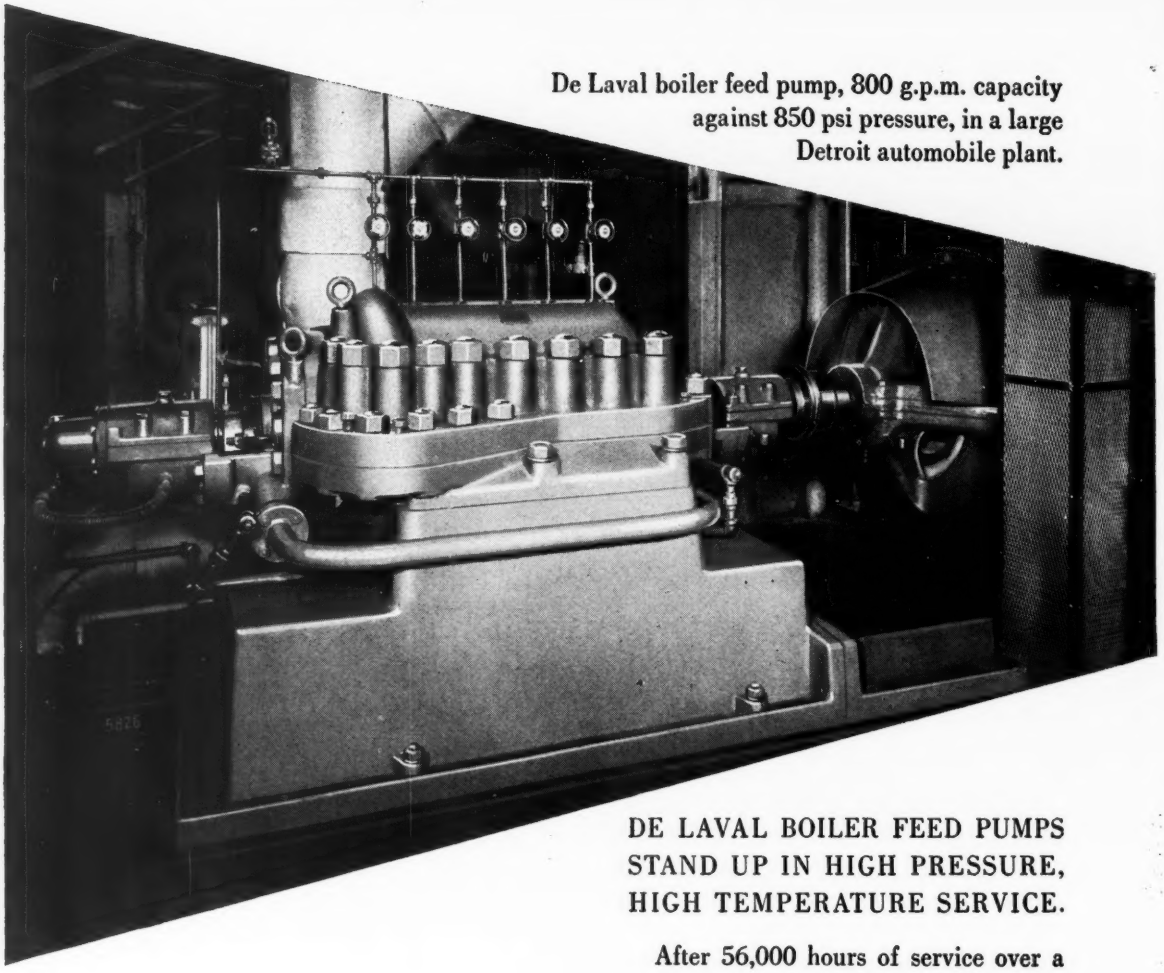
- High and Low Alarm Columns
- Split-Gland Water Gages
- Sight Flow Indicators
- Mica Shields and Gaskets
- Gage Glass Illuminators
- Sight Glass and Discs
- Safety Plastic Guards
- Steel Gage Valves
- Flat Glass Inserts
- Try Cocks
- Flat Glasses
- Tubular Glasses
- Refinery and Chemical Liquid Level Gages and Valves for All Kinds of Service, Etc.
- C-red Color Injector Liquid Shows Red, Steam Space Shows Green

STATE YOUR REQUIREMENTS

Send for Catalog

ERNST WATER COLUMN & GAGE CO.

Main Office and Works: 250 South Livingston Avenue, Livingston, New Jersey • Phone: Livingston 6-1400



De Laval boiler feed pump, 800 g.p.m. capacity against 850 psi pressure, in a large Detroit automobile plant.

"IN EXCELLENT CONDITION after 56,000 hours"

reports inspector

DE LAVAL BOILER FEED PUMPS STAND UP IN HIGH PRESSURE, HIGH TEMPERATURE SERVICE.

After 56,000 hours of service over a period of nine years, the power plant superintendent of a large Detroit automobile manufacturer asked for an inspection of this pump. The inspection was made and the following report received.

"We completely disassembled the pump and found wheels, diaphragms, shaft, bearings and all other parts in excellent condition. There was no washing of the pump case or any kind of corrosion. The shaft sleeve was highly polished. Balance parts including labyrinth leak off and the leak off bushing over the discharge end of the shaft sleeve hubs had but .005" wear."

In every detail De Laval pumps are designed for long trouble-free service.

Atlanta • Philadelphia • Charlotte • Pittsburgh
Cleveland • Rochester • Detroit • San Francisco
Chicago • New York • Denver • Kansas City
Helena • Boston • Houston • Washington, D. C.
St. Paul • Los Angeles • New Orleans • Seattle
Salt Lake City • Tulsa • Edmonton • Winnipeg
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DE LAVAL

DE LAVAL STEAM TURBINE CO.
TRENTON 2, NEW JERSEY

BF-4

TURBINES • HELICAL GEARS • WORM GEAR SPEED REDUCERS • CENTRIFUGAL PUMPS • CENTRIFUGAL BLOWERS AND COMPRESSORS • IMO OIL PUMPS

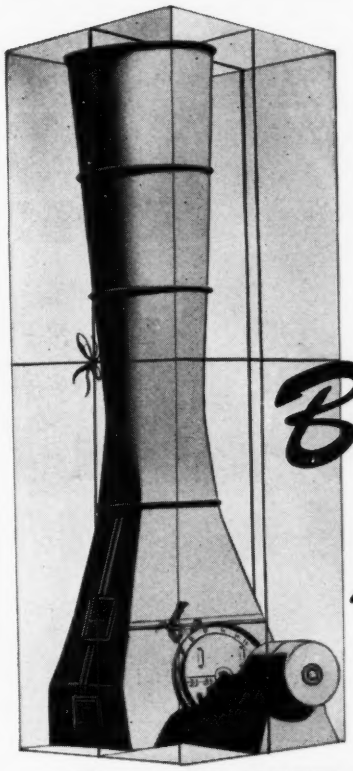
ADVANCED TYPE OF UNIT HEATER OFFERED BY PRAT-DANIEL

THERMOBLOC is a new design in Packaged Direct-Fired Unit Heaters, manufactured by the THERMOBLOC DIVISION of Prat-Daniel Corporation, East Port Chester, Connecticut. Applicable to heating large or small plants, this unit will provide an automatically controlled supply of heat at just the right temperature required. No ducts or steam pipes are required. This feature eliminates the possibility of freezing during shut-downs in winter and THERMOBLOC's instantaneous firing makes banking at night unnecessary. Heated air is circulated at working level and does not depend on a gradual building up of warm air from the ceiling down. During the summer, this unit may be used to circulate cool air, drawn from the floor level, to working level.

Two sizes are available. The THERMOBLOC 300, delivers 300,000 b.t.u.'s per hour, is 30" in diameter and 7' high. The THERMOBLOC 550, delivers 550,000 b.t.u.'s per hour, is 30" in diameter and 10' high. Both models are admirably adaptable to on-the-job construction heating because of their packaged feature requiring only the hooking up of power and fuel lines to place the unit in operation. Full details are available on request.

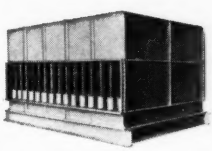
DUST COLLECTOR FOR SMALL SPACE-HIGH EFFICIENCY

A collector composed of small, multiple tubes is manufactured by the Prat-Daniel Corporation of East Port Chester, Connecticut, with claims of high efficiencies and low space factor due to its tubular design. Small diameter tubes increase centrifugal force on the dust, thus trapping the finer dust particles that would normally not be precipitated. This small tubular construction also permits close nesting of the tubes, appreciably reducing the size of the complete unit. According to the manufacturer, the size of the precipitating tube permits high efficiency with comparatively low velocities. This tends to reduce the possibility of excessive erosion. On actual installations, it was found that after a period of operation on fly ash, original scale on the inside of the tube was still evident, while some of the tubes showed signs of wear on the outside from stratification of the gas. Removal of the offending tubes rectified this and subsequent tests showed no signs of wear. Prat-Daniel Tubular Dust Collector forms the basis for the Duplex Collector. Efficiency of this apparatus is dependent on higher centrifugal force due to concentration in a smaller tube. Ultra-fine dusts are skimmed off and channeled through a secondary collector which need only have a capacity equal to 15% of the primary. Claims of cost and space reduction are made for this type collector.



Stack-
Breeching
-Fan

...ALL IN ONE PACKAGED UNIT



Save labor . . . save time . . . and get efficient, predetermined draft production for your boiler, with Thermix Fan Stacks.

Thermix Fan Stacks are scientifically designed to produce a definite controlled degree of draft. Built as a complete packaged unit, these stacks eliminate the problems of purchasing the three components, fan, breeching and stack, of a draft producing system separately.

In a Thermix Stack, the components are designed and coordinated to operate as a unit. Result, a complete draft-producing unit designed, engineered, manufactured and guaranteed by one company, thus relieving the engineer of responsibility for performance and placing it on the manufacturer, whose function it should be.

Thermix Tubular Collectors are made to complement this packaged design. A combination that offers the ultimum in draft and dust control.

Call the nearest field engineer or write our sales and project engineers for full details.

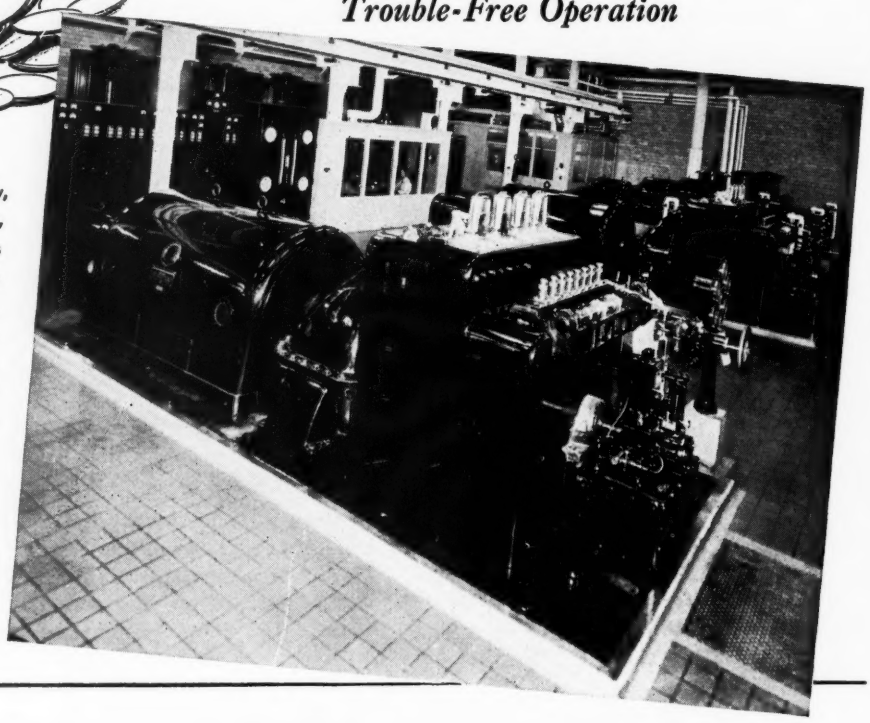
Sales and Project Engineers for Power Plant Division

THE THERMIX CORPORATION
Greenwich, Conn.

PRAT-DANIEL CORPORATION
EAST PORT CHESTER, CONNECTICUT

COST-CUTTERS YOU CAN DEPEND ON!

Worthington Turbine-Generators Set The Pace For Economical, Trouble-Free Operation



Two Worthington 2500 kw, 3600 rpm, 13,800 volt, 3-phase, 60 cycle Turbine-Generator Units at the Kaiser-Frazer plant in Willow Run, Michigan. They operate on steam at 250 lb. initial pressure, 470° F. total temperature, and exhaust at 27½" vacuum. Steam is automatically extracted at pressures from 15-50 lb. Installed in 1941, these Worthington Units supply both electric power and extracted steam for plant heating.

Worthington builds Turbine-Generator Sets in sizes up to 7500 kw, and in all types—including straight condensing, straight non-condensing, extraction, mixed pressure, mixed pressure extraction, low pressure and high back pressure.

Throughout industry these units are generating lower cost power, requiring only minimum maintenance, chalking up records of 99% — and better—for continuous operation, year after year.

IN YOUR OWN PLANT

Worthington engineers will be glad to study your power requirements, and to give you an estimate of the savings possible with the Worthington Unit that best meets your particular needs.

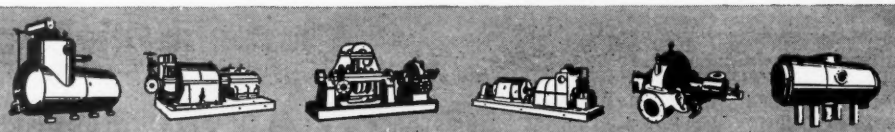
For further details proving *there's more worth in Worthington*, call your nearest Worthington District Office, or write to *Worthington Pump and Machinery Corporation, Steam Turbine Division, Wellsville, N. Y.*

WORTHINGTON

STEAM TURBINES

T8-2

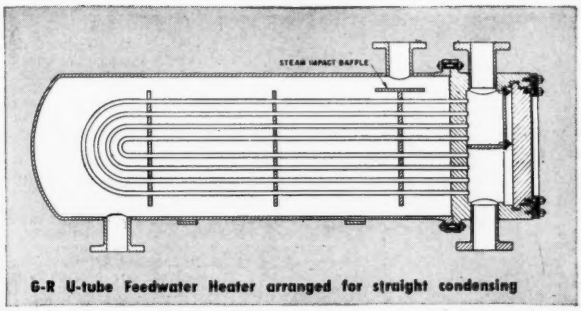
A GREAT TEAM IN STEAM



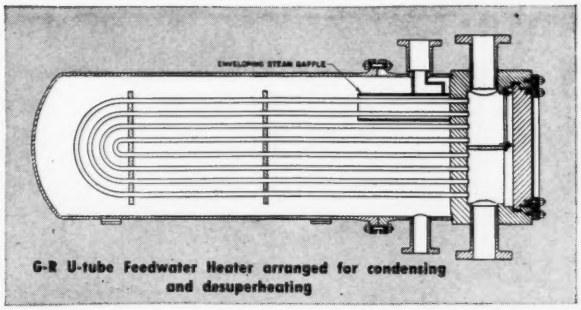
PROBLEM:

To select a feedwater heater that will efficiently transfer the heat from the available steam in the shell to the boiler feed water flowing through the tubes, with lasting freedom from trouble in service.

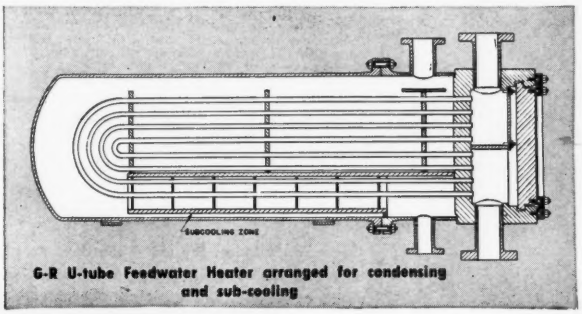
SOLUTION: A G-R FEEDWATER HEATER



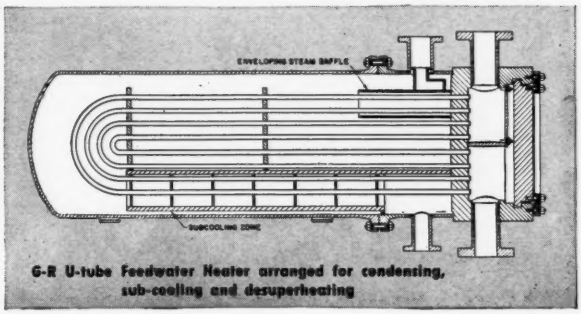
G-R U-tube Feedwater Heater arranged for straight condensing



G-R U-tube Feedwater Heater arranged for condensing and desuperheating



G-R U-tube Feedwater Heater arranged for condensing and sub-cooling



G-R U-tube Feedwater Heater arranged for condensing, sub-cooling and desuperheating

PROOF:

1. G-R Feedwater Heaters are designed for uniform steam distribution through the tube bundle—accomplished by proper proportioning and installation of steam impact baffles.

2. G-R Feedwater Heaters are baffled and supported to prevent high steam velocities, impingement of steam or drains on adjacent tubes, or vibration of tubes in support plates, and to protect the tubes from erosion and chafing.

3. G-R Feedwater Heaters are furnished with proper size of drain outlet connections to prevent backing up of condensate into the tube bundle and flooding of the heating surface.

4. G-R Feedwater Heaters for low pressures are amply relieved of air by means of an air baffle which sub-cools the vented air, thus reducing its volume and steam content.

5. G-R Feedwater Heaters cannot leak between passes at water heads because of their pass partition sealing plates which employ the pressure differential between the passes to keep the partition plate gaskets tight.

These are only some of the many superior features of G-R Feedwater Heaters . . . available in a large variety of types and sizes for all pressures and other service conditions. Write for Bulletin 279 describing these units in detail.

GR-212

THE GRISCOM-RUSSELL CO., 285 MADISON AVENUE, NEW YORK 17, N. Y.

GRISCOM-RUSSELL

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4 REASONS
DARTS DON'T DRIP

1. **EVERY DART . . .** is precision-machined to a true ball joint . . . then spherically ground to give wide, true-bearing surfaces. Reason why Darts fit snugly without excessive wrenching . . . are always leakproof.

2. **EXTRA-WIDE BRONZE SEATS . . .** resist pitting, electrolysis and corrosion . . . stay drop-tight.

3. **EXTRA-HEAVY SHOULDERS . . .** shrug off wrench abuse through dozens of installations.

4. **PRACTICALLY INDESTRUCTIBLE . . .** body and nut of air-refined, high test malleable iron resists stress, stretching and wrenching . . . ensures that connections will stay tight.

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E. M. DART MANUFACTURING CO.
PROVIDENCE 5, RHODE ISLAND

DART
UNIONS

HELPFUL BULLETINS

(Continued from page 36)

METALS

126 **Standard Steel Lists** — Technical Data Card No. 119 C contains 4 pp of data on steels, including chemical composition limits and the AISI and SAE numbers. Covers basic open hearth and acid-Bessemer carbon steels and resulfurized carbon steels, open hearth and electric furnace alloy steels, and stainless and heat resisting steels. Printed on firm stock; ring punched for binding. The Babcock & Wilcox Tube Co.

127 **Electronic Alloy Data** — This 26-pp booklet describes the electrical and electronic properties of 18 high nickel alloys. It lists their mechanical and other properties and the forms in which they are available and cites typical uses. The International Nickel Co., Inc.

MISCELLANEOUS

128 **Lubrication Cost Reductions** — "Studies in Centralized Lubrication," an 8-pp booklet, presents actual case histories of savings afforded by the application of manufacturer's centralized system of lubrication. These cover its use in presses, shaker screens, traveling cranes, rock crushers and mills, and point out cost reduction in terms of less power, less hand labor, fewer bearing failures and fewer repairs because of better lubrication. The Farval Corp.

129 **Insulation Bulletin**—Insulating materials and preformed insulations for buildings, roofs, pipes, low temperature structures and acoustical purposes are described and illustrated by photograph in Form No. G-48-6, 8 pp. Gives physical properties, thermal conductivities, available forms and specifications, also installation tips. Sound absorption coefficients are given for acoustical insulation. Also described is an extra fine, light insulation for thermal and acoustical application. Owens-Corning Fiberglas Corp.

CATALOG LIBRARY

This monthly list of the latest standard catalogs and bulletins is designed to aid the engineer in maintaining his permanent catalog file of engineering data. The items listed, unlike those under Helpful Bulletins, will appear each month except for additions and deletions determined by space requirements or by the manufacturers issuing the bulletins. Use the Helpful Bulletins coupon in requesting these copies.

BOILERS AND AUXILIARIES

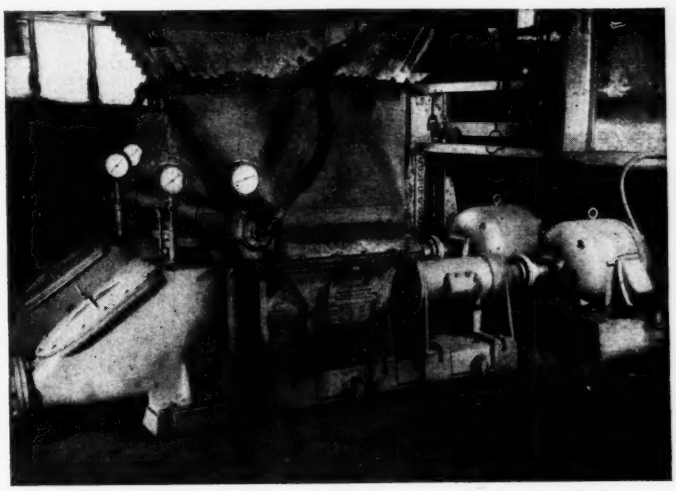
201 **Working Pressure Data Card**—Maximum allowable working pressures for water tube and fire tube boilers are compiled in a handy reference table, Technical Data Card No. 113 A. It lists pressures in pounds per square inch for seamless and electric resistance welded carbon steel tubes or nipples for different diameters and gages of tubes conforming to ASME specifications. Chart covers 2 letter-size pages, is printed on firm stock, and punched for use in binder. The Babcock & Wilcox Tube Co.

202 **Blast Furnace Gas Burner Bulletin** —Said to be the first published on the subject. Bulletin No. 500, 4 pp, describes operation of these burners and discusses their adaptability for use not only with waste fuels, but also in combination with auxiliary fuels and by means of auxiliary fuels alone. Contains pictures of gas burner installations and cross section drawings of various other types of burners for waste and primary fuels. Peabody Engineering Corp.

203 **Heat Exchangers Data Book** — Illustrations and pertinent data on the company's complete line of redesigned heat exchangers are presented in Bulletin 1.1K1. This 8-page booklet presents cut-away views illustrating construction and line drawings showing sizes,

FULLER KINYON

SYSTEMS *for* PULVERIZED FUELS



Two Fuller-Kinyon Stationary Pumps installed in the plant of Calumet and Hecla Consolidated Copper Company, Lake Linden, Michigan, for conveying pulverized coal.

TYPICAL MATERIALS CONVEYED BY FULLER-KINYON SYSTEMS

- Asphalt filler dust
- Barytes
- Bauxite
- Catalyst
- Cement (Portland)
- Cement raw materials
- Chalk
- Clay (dried)
- Coal (pulverized)
- Coke dust
- Dolomite (pulverized)
- Feldspar
- Flue Dust
- Fly ash
- Fuller's earth
- Gypsum (calcined)
- Gypsum (raw)
- Lime (quick)
- Limestone (pulverized)
- Magnesite
- Manganese dioxide
- Ores (pulverized)
- Phosphate rock (pulverized)
- Rock Dust
- Soda ash
- Starch

The Fuller-Kinyon Conveying System has been used for many years for conveying pulverized coal for the firing of rotary kilns and dryers in the cement industry, boilers in industrial plants, and large central power-generating stations. Also for metallurgical furnaces for gasification and by-product recovery; nodulizing, pelletizing and briquetting in metallurgical processes in which an ore is mixed with the fuel.

These systems have replaced many worn out or obsolete mechanical systems, with their fire and explosion hazards. The Fuller-Kinyon System is absolutely safe from such hazards, due to the fact that the quantity of air required for aeration of the material being conveyed is less than one percent of that necessary for combustion. The system is efficient, clean, and low in power consumption. The conveying pipe lines can be carried overhead, hung on simple hangers, or buried underground. Will convey horizontally, vertically, or uphill. Present systems convey materials as far as 3600 feet; elevations to 300 feet.

If you have a pulverized fuel conveying problem, or other dry pulverized materials to be handled, our engineers will be glad to make a study of your layout and make recommendations for the economical handling of such materials. It will cost you nothing; no obligation on your part.

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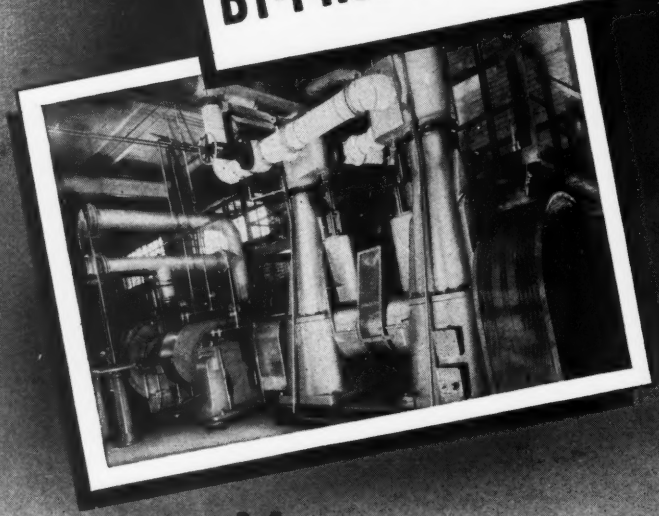
FULLER

FULLER-KINYON, FULLER-FLUXO, AIRVEYOR, F-H AIRSLIDE CONVEYING SYSTEMS . . . ROTARY FEEDERS AND VALVES . . . ROTARY COMPRESSORS AND VACUUM PUMPS . . . INCLINED-GRATE COOLER . . . DRY PULVERIZED-MATERIAL COOLER . . . MATERIAL-LEVEL INDICATOR . . . AERATION UNITS . . . AIRLIFT . . . CONSTANT-HEAD FEEDER . . . SLURRY VALVES . . . MOTION SAFETY SWITCH . . . SAMPLERS

P-105

TROY-ENGBERG
STEAM ENGINE

SAVE
BY USING
BY-PRODUCT POWER



Make your STEAM do two big jobs . . . eventually one of them at little or no cost. With proper heat balance your steam can provide—FIRST, power for driving equipment, and SECOND, heat units needed for processing or heating.

Use boiler steam to run a Troy-Engberg Steam Engine. THEN use the exhaust in your heating or processing lines. Drive your pumps, stokers, generators, blowers or compressors with By-Product Power. Use a Troy-Engberg Steam Engine as a reducing valve and your power cost saving will pay for the engine in a very short time.

Send for Bulletin 306

TROY ENGINE & MACHINE COMPANY
Established 1870
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TROY-ENGBERG
STEAM ENGINES • GENERATING SETS • GENERATORS

dimensions and weights. Brief text on various applications of this all-nonferrous unit is presented. Ross Heater & Mfg. Co., Inc.

VALVES, TRAPS, PIPING

204 **Pipe Distribution System Data** — "Engineering Distribution Data for Underground Steam Distribution," is the title of Section 480-2, 34 pp, of practical usefulness to those who deal with problems involved in insulated piping distribution systems. It covers layout of the route and methods of estimating steam loads, includes steam flow charts and tables, and gives properties of steel pipe, copper water tube piping and saturated steam. Also gives specifications of steam and hot water distribution piping with prefabricated pipe conduit. It's illustrated with photos of field installations and industrial applications of insulated pipe units, also sketches showing method of making field closures. The Ric-Wil Co.

205 **Piping Materials Catalog**—Corrosion resistant valves and piping materials are covered in illustrated circular No. 320, 32 pp. Contains information on manufacturer's complete line of valves, fittings, fabricated piping and pipe coils to meet a wide range of corrosive conditions. Listing includes both photos and cutaway drawings of models, complete specifications, sizes and prices. Includes a description of alloy metals used and a corrosion questionnaire. Also included are several pages of condensed recommendations on the selection of piping materials according to service requirements as well as a pictorial chart showing basic types of valves with names of their component parts. Crane Co.

206 **Steam Trap Catalog** —Thermostatic Steam traps for high pressure industrial service are covered in manufacturer's revised Bulletin 250A, 8 pp. Contains general discussion on these traps, how they're made and how they operate. Includes dimensions, specifications and capacities of traps listed, also prices. Cut-away photos show construction details and sketches show hook-ups. Sarco Co., Inc.

207 **Pipe Hanger Catalog** — Ninety-page Catalog 10-D is a valuable buyer's guide for adjustable pipe hangers and supports. Covers hangers for attachments to pipe and to structure, hanger assemblies, spring hangers, hanger rods, pipe supports and related equipment. Each type described and illustrated by photo and dimensional diagram and listed with dimensions and prices. Catalog also includes standard specifications, photos of installations and terms of sale. Indexed for quick reference; punched for filing in binder. Grinnell Co., Inc.

208 **Valves Bulletin**—A new catalog section 12-H describes all types of the company's cast steel pressure-seal bonnet valves. Information on choosing the best size valve for your service is given in one page of the booklet under the title, "Correlation of Valve Size and Pressure Drop." Design and construction advantages of the valves are given and tables of pressure and temperature ratings. Details of design including operating mechanism, body design, disk piston, and other features are explained. Dimensional details are given in tabular form accompanied by dimensioned line drawings. A standard materials specification table is presented. Edward Valves, Inc.

209 **Rubber Expansion Joints** — This 8 page bulletin AD 137 tells about the application, construction, styles, service and advantages of the company's line of rubber expansion joints. Other informa tion given, includes "How To Order" and a table of dimensions which is accompanied by dimensioned line drawings. The bulletin is well illustrated. The Garlock Packing Company.

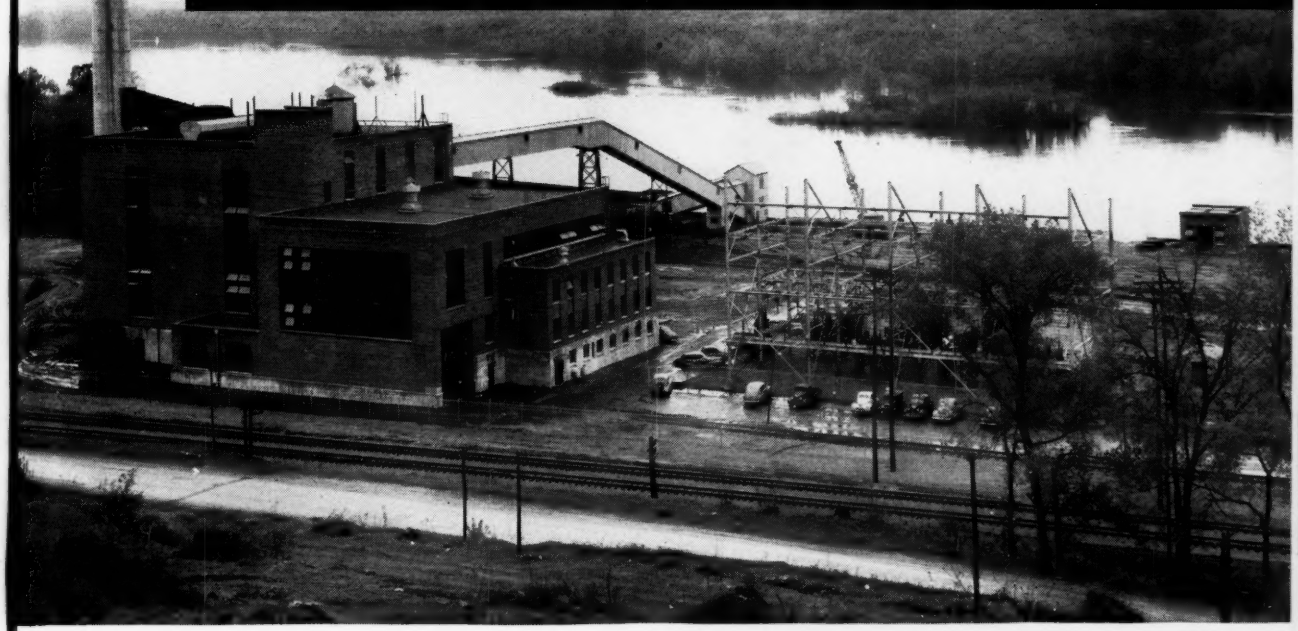
210 **Draining System Bulletin**—Draining and air venting of paper machine cylinders are treated in eight-page Technical Bulletin No. 3. Discusses requirements of an efficient method of draining and air venting dryer rolls and tells how manufacturer's system meets these requirements. Sketches and diagrams show unit and installations. Sarco Co., Inc.

HEATERS, HEATING

211 **Space Heaters**—Bulletin 523, 12 pp, covers forced air space heaters, di-

Mark the numbers of the bulletins you wish to receive on the no obligation, no postage card. Pages 35-36.

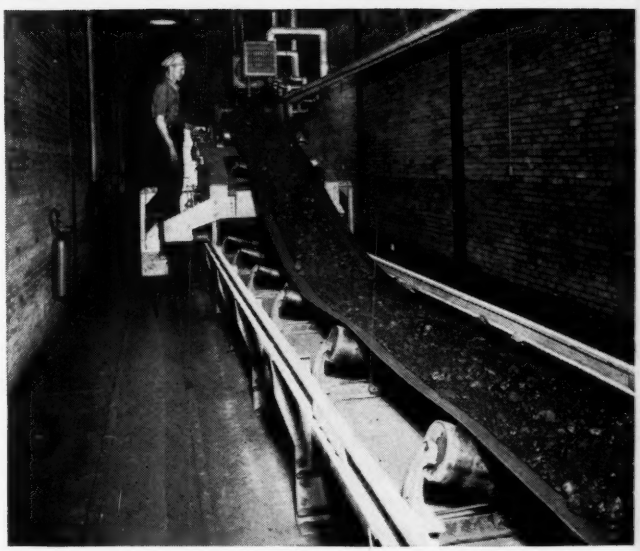
Barge to Bunker Coal Handling at Cooperative's Alma Steam Plant



Dairyland Power Cooperative's new Alma steam station of 30,000 KW delivers power into the Co-op's transmission system, to which are connected three other Co-op plants. This station is also connected with a private power system.

Link-Belt conveyors play an important part at Alma. Coal arrives in river barges and goes to ground storage or to receiving hopper of conveyor system. Handling units comprise the following: receiving hopper with rack-and-pinion discharge gate . . . inclined overlapping steel apron feeder . . . belt conveyor, 102′ long, inclined 18° . . . ring crusher . . . belt conveyor 185′ long, inclined 18° for carrying crushed coal or for receiving coal that does not require crushing . . . Weightometer for weighing coal in transit . . . inclined and horizontal belt conveyor, 235′ long, equipped with self-propelling, hand reversing belt tripper operating on T-rail tracks mounted across top of coal bunkers. Water for the steam-condensing unit is taken from the Mississippi through two Link-Belt traveling water intake screens located in a screen house.

The design and construction of the entire plant was handled by Vern E. Alden Company, Chicago. For details of coal handling equipment of this or other plants, get in touch with the nearest Link-Belt office.



Top: General view of Alma Steam Power Station as seen from bluffs, looking toward Mississippi River. Above: Link-Belt 24" wide roller bearing belt conveyor with self-propelling hand-reversing "Tank" type tripper for discharging coal to tankers; also shows the plow and belt-seal arrangement against escape of dust.

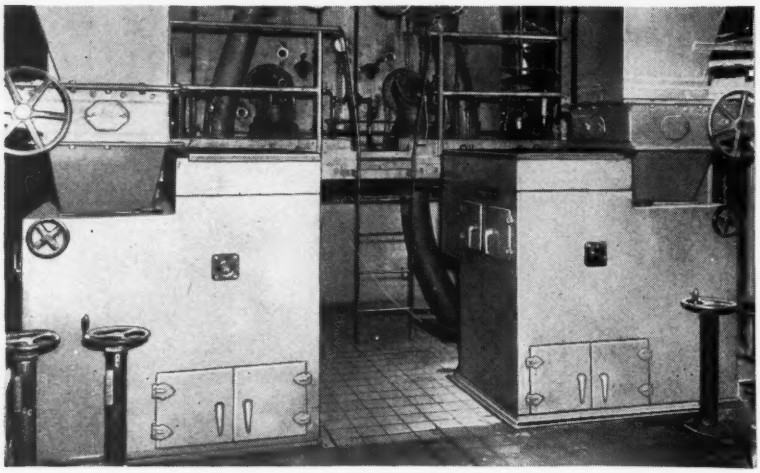
LINK-BELT COMPANY Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8. Offices in Principal Cities. 11,432

LINK-BELT

CONVEYING MACHINERY

"THE COMPLETE LINE"

ON GUARD.. TO KEEP COAL COSTS DOWN



At ROCKLAND LIGHT AND POWER COMPANY'S NEW HUDSON PLANT

Maximum operating economy, in spite of increasing power costs, was the primary consideration in the design of the new 120,000 kw. (ultimate capacity) steam plant of Rockland Light and Power Co., at Tomkins Cove, N. Y.

The first unit, of 20,000 kw., in operation since March, 1949, is one of a series of standard plants — designed by Burns and Roe, Inc., Engineering Consultants, to realize the ultimate in economy from both plant layout and equipment. Richardson Automatic Coal Scales were selected to assure accurate records of coal consumption.

Two Model EE39, 200-lb. units, one right hand and one left hand, each with 15T/Hr. capacity, automatically weigh coal from 290-ton overhead bunker to pulverizers. Scales were supplied complete with electric timer type "no-flow" alarm to warn of any interruption in flow of coal; dustproof, siftproof, double rack-and-pinion, ball-bearing gates to control flow; and dust-tight, flexible inlet connections to seal joints and eliminate pressure on scales.

For over 40 years Richardson Automatic Coal Scales have been helping central stations and industrials eliminate preventable coal waste and produce more power at less cost... a good reason for calling on Richardson when you plan to modernize your present plant or build a new one.

For further details on Richardson Coal Scales, *write for Bulletin No. 1143-G*

RICHARDSON SCALE COMPANY, Clifton, N. J.

ATLANTA • BOSTON • BUFFALO • CHICAGO • MINNEAPOLIS • WICHITA
NEW YORK • OMAHA • PHILADELPHIA • SAN FRANCISCO • DETROIT • PITTSBURGH • MONTREAL • TORONTO

rect-fired by oil, gas or combination fuel and ranging in output from 400,000 to 2,000,000 Btu, for comfort heating, year-round ventilating, tempering make-up air, process drying and heat curing. It discusses their design and principle of heat distribution and lists 18 reasons why these heaters are recommended for open space heating. Includes specifications, capacity and dimension tables, sketches illustrating operating principles and construction details and photographs showing the heaters in use. Dravo Corp.

212 **Fan Heater Bulletin**—Here's a 2-pp illustrated bulletin (No. 109) on a new high pressure steam fan heater designed for complete utilization of both sensible and latent heat of high pressure steam. One page is devoted to description and photos of the heater. Other page contains a sketch in color showing how the heater works. Niagara Blower Co.

213 **Heating Element Data**—Bulletin No. 20, 8 pp, contains detailed capacity and dimension tables on manufacturer's "Paracoil" heating elements. Illustrations and descriptions provide instruction for installation of heating elements and diagrams show six commonly used installation arrangements of hot water generation using these heating elements and storage tanks. Includes conversion table for steam and temperature conditions for determining capacity of any size heating element. Davis Engineering Corp.

214 **Steam Humidifiers**—Bulletin 1771 describes the company's steam humidifiers for automatically controlling relative humidity for the prevention of dry air damage to hygroscopic materials such as paper, leather, wood, cork, foodstuffs and other materials in storage or in process. The bulletin also describes the effect of relative humidity on human comfort and help and explains how maintenance of proper humidity will eliminate the fire and explosion hazards of static electricity where inflammable dust, vapors or liquids are present. Tables and charts are included on desirable relative humidity in various industries. Two useful sections of the bulletin are "How to Select," and "How to Install," both of which are accompanied by excellent line drawings presented in two colors. Armstrong Machine Works.

215 **Tubular Heat Exchangers**—Bulletin 916 is a particularly informative 32 page bulletin which has "just been issued." The bulletin describes the present designs of the company's tubular heaters, coolers, condensers and heat exchangers and their distinctive features. The various types of shells, tube bundles, stationary heads and floating heads are fully explained, together with statements of the particular services for which each is suitable. An additional helpful feature of the bulletin are tables of the characteristics of tubing, the thermal resistance of tubes and pipes of many different metals and alloys, and the specific gravity and pounds per gallon corresponding to degrees Baume and degrees API. Also presented is a chart of the specific heats of midcontinent crude oils and the charts for solving the MTD formula with correction factors for other than countercurrent conditions. The Griscom-Russel Co.

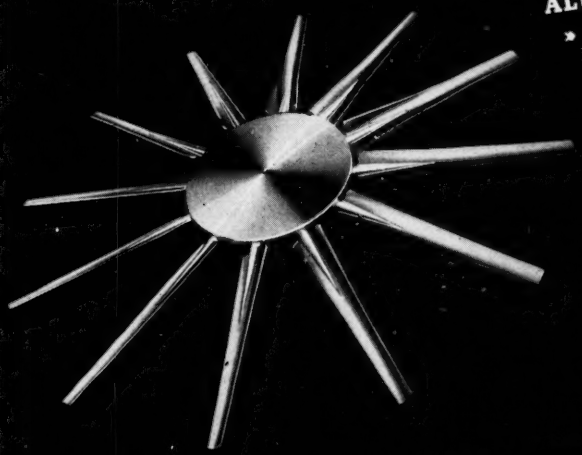
TREATMENTS, PREVENTIVES

216 **Protective Coating**—Bulletin 1540, 4 pp, is devoted to a corrosion resistant coating for cold, wet surfaces. Tells its protection against corrosive effects of natural fresh and salt water, cold acid and alkali solutions, acid fumes and atmosphere under shelter. Discusses in detail the use of this coating in water storage tanks and in condensers. Tells how coating should be applied and how to order it. Bulletin also includes photos and description of equipment recommended for use in applying the coating. The Dampney Co. of America.

217 **Corrosion Analysis**—Excellent working data on galvanic corrosion is contained in this 8-pp technical study of corrosion by concentraion cells, reprinted from Inco Corrosion Reporter, Vol. 3, No. 1. Discusses concentration cells, the metal-ion cell type, oxygen cell type, reversible concentration cells, their practical aspects and some rules for minimizing or preventing concentration cell corrosion. Illustrated with sketches showing conditions which accelerate corrosion. The International Nickel Co., Inc.

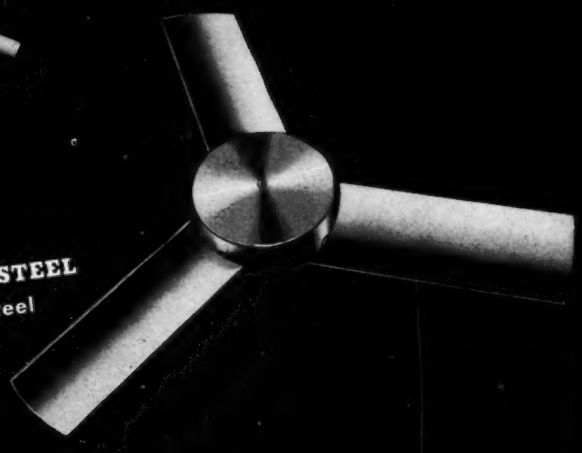
218 **Turbine Blade Deposit Study**—Identification and prevention of steam turbine blade deposits and boiler water conditioning to prevent such deposits are discussed in the new 16-pp illustrated Bulletin 28B7030. Describes x-ray diffraction methods employed by the company for

NEW Marley FANS For Cooling Towers and DriCooler* Do The Job Better . . . Longer



ALUMINUM

» Multibladed » Balanced
» Unusually quiet and smooth operation
» High tensile cast aluminum alloy
» Adjustable pitch » Air foil section
» Twisted and tapered blades



STAINLESS STEEL

» All stainless steel
» Adjustable pitch » Balanced
» Air foil section
» Quiet and smooth operation

FAN CYLINDER

» Unusually rugged » All bolted
» Flared throat
» Non-corrosive

Marley Fans and Fan Cylinders team up to do the job better . . . longer! These fans are designed and manufactured by The Marley Company especially and exclusively for water cooling applications.

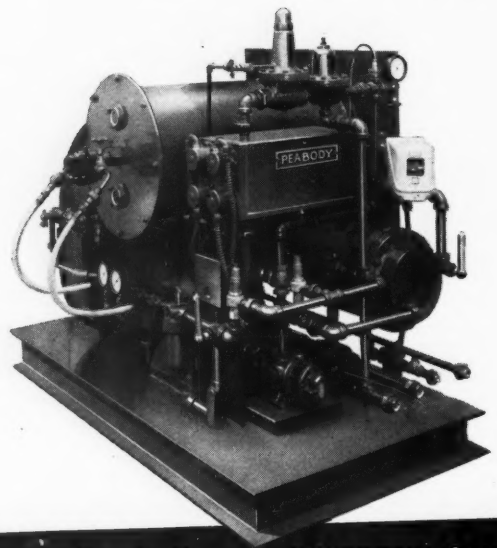
Your new MARLEY Water Cooling Tower or "DriCooler"* will have this equipment, but you can improve your present water cooling tower, right now, regardless of size or make with these new MARLEY FANS.

*DriCooler is the exclusive trade-mark of The Marley Company, Inc., and designates its finned tube dry surface cooling equipment.

MARLEY

THE MARLEY COMPANY, INC. • KANSAS CITY 15, KANSAS

A COMPLETE AUTOMATIC OIL BURNER SYSTEM



to fire boilers and furnaces from 100 developed HP upward

If you're interested in improved plant layout, low operating costs, and reduced overhead on your heating and power plant installations, you'll be interested in the Peabody Automatic Burner. Designed, built, and engineered by Peabody, the Automatic Oil Burner is a compact, complete oil combustion system that takes Bunker "C" or lighter oils from your storage tank, pumps it, preheats and delivers it to the burner at the proper viscosity and then burns it at the specified firing rate dictated by operating demands.

DEPENDABLE

The Peabody Automatic Burner is listed by Underwriters' Laboratories, Inc. and has a complete system of checks, safeguards, and automatic controls to maintain the required firing rate that assures maximum efficiency and safety at all times. Available for both fully-automatic and semi-automatic operation.

READY TO INSTALL

The entire assembly is mounted at the factory on a common base. No extra construction or engineering necessary to put it into operation. Just bolt it to furnace front, and make necessary service connections. It's simple, safe, and dependably economical!

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PEABODY
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Manufacturers of all types of combustion equipment, direct-fired air heaters, gas scrubbers, coolers, and absorbers.

204

OFFICES IN PRINCIPAL CITIES

identification purposes and the results obtained. Tables list the partial chemical analyses of deposits containing sodium disilicate, occurrence data on compounds found, composition of turbine deposits from turbines operating at various throttle pressures and temperatures, and comparison of compounds found in turbine blade deposits with boiler operating pressures. This is the 10th in manufacturer's series of engineering bulletins. Allis-Chalmers Mfg. Co.

219 **Boiler Water Manual**—Factual information on standard methods of applying chemicals in the treatment of water for boilers is presented in this 16-page technical bulletin, called Standard Method 122. Discusses pretreatment of raw water, application of chemical feeding to pretreating operations and both constant rate and flow responsive feeding direct to boiler drum and to feedwater systems. Also discusses condensate returns, flushing periods, condenser cooling water treatment and chemical tanks. Illustrations include photographs of two feeders and diagrams of the various methods described. Punched for filing in ring binder. Proportioneers, Inc.

220 **Water Conditioning Bulletin**—This is an eight-page discussion of water and chemicals developed for conditioning it to control scale and algae and inhibit corrosion. Describes several chemicals in detail, giving properties, composition and application. Also discusses special purpose chemicals. Wright Chemical Corp.

221 **Antifoaming Compound**—This new technical bulletin covers the company's latest product known as Antifoam 8. With the accelerated rate of operation in many power plants today, foaming from either chemical or mechanical origin has become one of the prime problems in boiler operations. This technical bulletin presents reasons for foaming and deals with the chemical causes, especially the application of antifoams to elimination of carryover from these causes. After discussing the causes for foaming the bulletin goes on to describe the proper dosage and feeding and results obtained from the use of Antifoam 8. E. F. Drew & Co., Inc.

222 **Corrosion Resistance of Nickel Alloys**—Technical Bulletin T-3 contains 44-pp of illustrated information on the resistance of high nickel alloys to corrosion by sulfuric acid. Although technical in nature, it is written so as to be readily understood by non-technical staffs. Performance of 30 nickel-bearing materials in a wide range of service is discussed, and there are 86 tables and 33 graphs and photos in addition to text. Problems involving a wide range of operations from the pickling of steel to petroleum refining and textile processing are covered. The International Nickel Co., Inc.

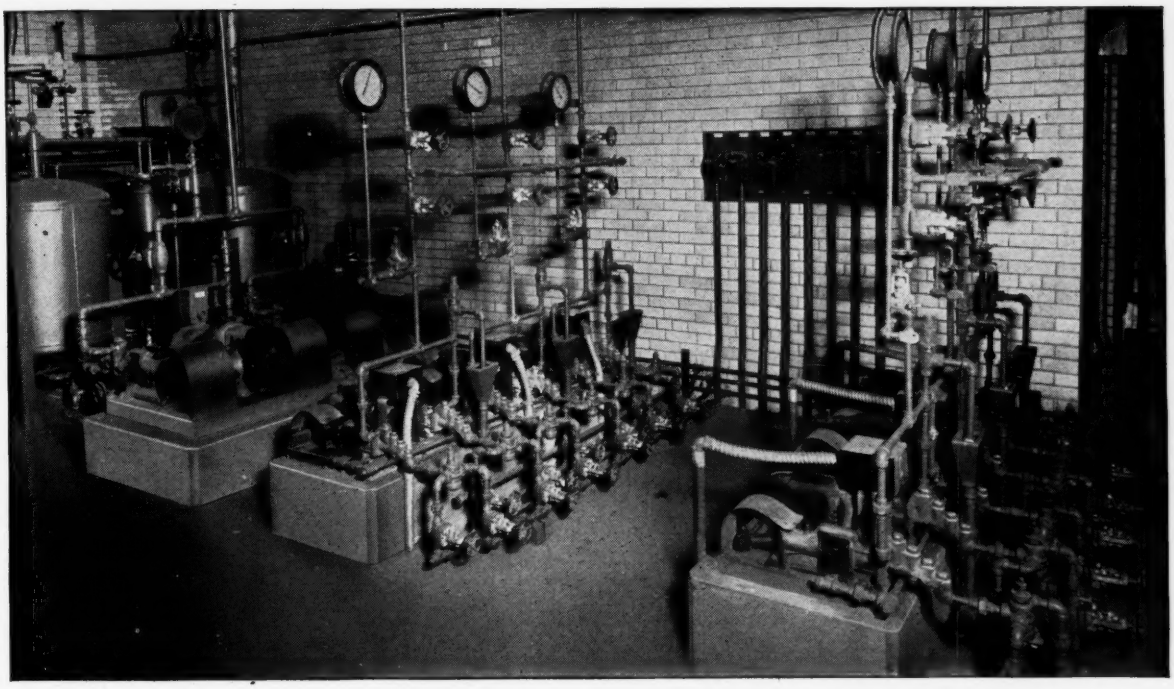
223 **Magnesium Anode Data**—General information on magnesium anodes for cathodic protection of pipe lines and other metal structures is provided in 5 letter-size sheets. It covers applications of cast, packaged, flexible ribbon and extruded anodes. Gives composition of magnesium alloy used and includes ratings, dimensions, sketches and prices. Dowell Inc.

224 **Rust Prevention Data Book** — This loose-leaf collection of data sheets covers the story of the company's various types of No-Ox-Id Protective Coatings. The first bulletin tells the general story of the characteristics of the protective coatings and the remainder give such data as: Physical Description; What It is Used For; Coverage; Preparation of Surface Before Application; Method of Application; Drying Time; Recommendations for Storage; Fire Hazards; Resistnace; and others. Dearborn Chemical Co.

225 **Boiler Corrosion**—A 12 page article discussing the cause and prevention of corrosion in boiler systems is presented in Betz Technical Paper No. 111 titled "Corrosion: Its effect in Boiler Systems." The corrosive effects of oxygen, carbon dioxide, ammonia, hydrogen sulfide, acidity and physical factors are evaluated. Numerous illustrations, graphs and tables aid in understanding the article. W. H. & L. D. Betz.

226 **Application Data Bulletin** — Titled "The Aroclors," chlorinated biphenyl and chlorinated poly-phenyls, this

Mark the numbers of the bulletins you wish to receive on the no obligation, no postage card. Pages 35-36.



FOR BOILER WATER CHEMICAL TREATMENTS

Specify • Milton Roy Chemical Pumps
• Milton Roy Chemical Feed Systems

Proof of "Performance" in chemically treating boiler water are the many installations of Milton Roy equipment in modern utility and industrial power plants . . . both complete Milton Roy "Packaged" Systems engineered for specific applications and Chemical Pumps as components in systems developed by plant engineers. In the plants listed below typical installations of such equipment have been made in recent months.

SPRINGS COTTON MILLS, GRACE, S. C. (Complete packaged systems, including tanks and accessories, for handling both sulfite and phosphate feeds.)

ESSEX (NEWARK) GENERATING STATION, PUBLIC SERVICE ELECTRIC & GAS CO. (Pumps.)

LANSING (MICH.) STATION, INTERSTATE POWER CO. (Pumps and tanks for feeding sulfite and phosphate.)

EAGLE POINT WORKS, TEXAS CO., WESTVILLE, N.J. (Pumps.)

MANSFIELD TIRE & RUBBER CO., MANSFIELD, OHIO (Pumps.)

SOUTHWARK STATION, PHILADELPHIA ELECTRIC CO. (Packaged systems, for feeding sulfite and phosphate. Shown above.)

Milton Roy Packaged Systems include all necessary pumps, solution tanks, covers, gage glasses, low level cutouts, alarms and motor starters. They can be supplied with automatic electronic controls to operate pumps at speeds proportional to feed water flow as measured by a flow meter. Available to handle all treating chemicals and in capacities to meet all pressure and capacity requirements.

Details in Bulletin 451 . . . ask also for Technical Paper 51 "What the Power Engineer Needs to Know About Chemical Feed Systems."

MILTON Roy COMPANY

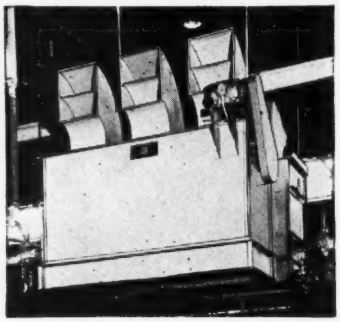
WITH THE EXCLUSIVE STEP-VALVE DESIGN

1320 E. MERMAID LANE, CHESTNUT HILL, PHILA. 18, PA.

New HIGH PRESSURE STEAM Fan Heater

Gives Savings You Never Had Before

The first heater to make High Pressure Steam really trouble-free and practical in plant heating. Every engineer should understand its original method; write for Niagara Bulletin and performance data.



HOW IT OPERATES: — A dual coil system makes use of all heat, both sensible and latent. High pressure steam enters the upper coil, shown on the diagram below. Its condensate drains into a trap. Then this high pressure condensate is released into the header of the lower coil. It instantly flashes into steam at vapor pressure.

Any high pressure condensate that remains liquid is carried to the vapor condensate return header by a drain tube that also gives off its heat into the air stream.

The vapor condenses in the lower coil. Its condensate is kept at a high level in the return leg by a wier in the return header so that all its heat is made useful and it is sub-cooled by contact with the coldest air entering the heater. Vacuum condensate return to boiler is vapor free.

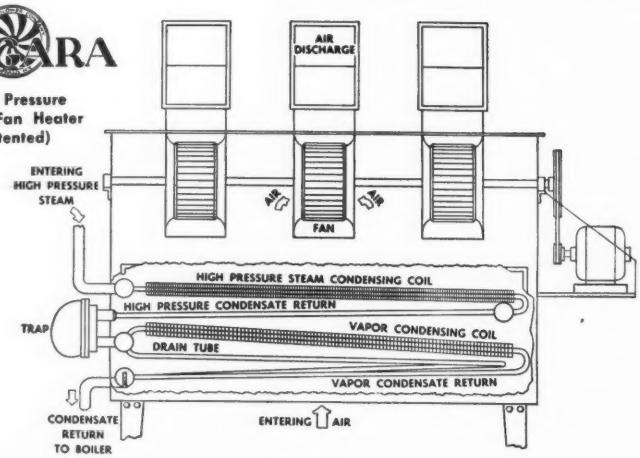
HOW IT SAVES IN COST: — Piping is much simpler and less costly than in low pressure systems. Much secondary piping, traps and big valves are not needed. Pipe sizes are smaller.

HOW IT SAVES IN OPERATION: — Waste is prevented. Every BTU goes where you want it. No dump traps or hot wells waste live steam.

HOW IT SAVES IN UPKEEP: — Condensate flow is even, vapor free, easily handled. No sudden surges of condensate in starting. No hammering, no hard wear and tear on system. Properly engineered for the job, final air temperatures are not excessive; heat easily directed where needed; no flashing of low pressure condensate. Heaters are self-draining on shut-down. Heaters are strongly built; all coils including the condensate drain tubes are hairpin bend, stress relieving. Use thru four heating seasons has proven these advantages in large scale plant heating.

NIAGARA

High Pressure Steam Fan Heater (Patented)



NIAGARA BLOWER COMPANY

Dept. PG 405 LEXINGTON AVE., NEW YORK 17, N. Y.

Please send Bulletin 109 on the Niagara High Pressure Steam Fan Heater.

Name .....

Address .....

booklet describes the unique properties which enables this material to fulfill certain requirements. The Aroclors have won a place in the electrical insulating field and in such widely differing applications as non-flammable hydraulic media, high-temperature and high-pressure lubricants, heat-transfer and expansion media, sealing compounds, adhesives and protective coatings, including plastics, pigments, lacquers, paints and varnishes. This booklet contains 28 pages and presents the combined information gathered by the company from what it believes it to be reliable and dependable sources. Monsanto Chemical Co.

ELECTRICAL

227 **Electrical Diagram Guide**—The purpose and use of electrical diagrams supplied with switchgear equipment are explained in Bulletin GET 1293A. It was written to help those who install, operate or maintain switchgear equipment make the best use of the diagrams that come with such equipment. Discusses in detail one-line, elementary, connection and interconnection diagrams. It tells their scope and uses and illustrates symbols used and common variations and explains ASA device function numbers and conventions. General Electric Co.

228 **Transformer Buyers Guide**—An excellent technical manual on instrument transformers is this 80-page catalog, GEA-4626B. Contains descriptions, photographs and index of ratings and construction for indoor and outdoor potential transformers, indoor and outdoor current transformers, outdoor metering outfits and portable potential and current transformers, according to cycles. Dimensions, prices and shipping weights are included with listing of each type, as is reference to manufacturer's bulletin dealing with that type of transformer. Index of types shows voltage and frequencies. Also included are tables showing mechanical and thermal limits of current transformers. Book has firm covers and ring binding for long-time reference use. General Electric Co.

229 **Induction Motor Bulletin**—A four-page illustrated folder, PB 7000-1, describes manufacturer's new two-pole, 200 to 3500 hp induction motor of fabricated steel construction, available in enclosed or separately ventilated types. Construction features are discussed in detail and illustrated with photographs. Elliott Co.

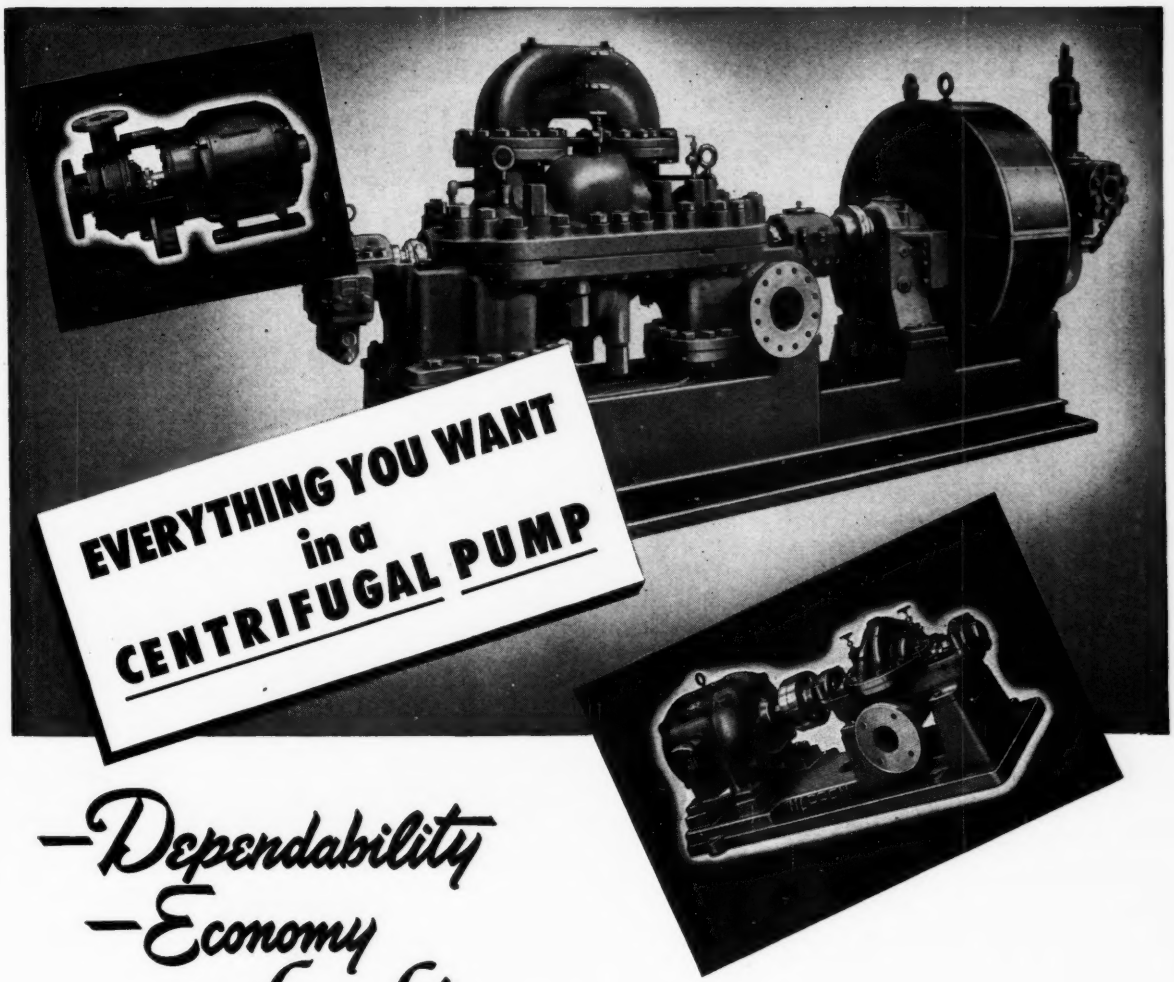
230 **Synchronous Generators**—This Bulletin, 05B6139A, describes construction features and electrical characteristics of engine-type synchronous generators in standard ratings from 25 to 10,000 kva and for standard speeds from 100 to 600 rpm, for Diesel, steam or gas engines. Also describes and illustrates mechanical construction of stators and rotors and discusses machine characteristics, ratings, voltages, frequencies, phases, temperature rises and operation at high elevation. Illustrations show typical installations. Available control accessories are listed, as are manufacturer's other products and territorial sales offices. Allis-Chalmers Manufacturing Co.

231 **Magnet Catalog**—Twenty-eight page Catalog CDM-2A is a handy ordering guide for stocked permanent magnets of cast and sintered Alnico and special magnetic alloys. Contains photos, dimensions and pull curves of many stocked magnets and drawings of all stocked patterns. Includes tables showing physical properties and tolerances of cast and sintered Alnico, also conversion table. Outlines procedure for requesting magnet design assistance from manufacturer. General Electric Co.

PUMPS, COMPRESSORS, ENGINES

232 **Pumps, Condensers** — This bulletin is a condensed catalog of the products, plants facilities and services of this company. A concise description of the services offered by nine divisions of the company are presented in the bulletin and a summary of the combined services and products offered by the various units is given on one page. A listing of the general maintenance service and bulletins and catalogs available also are presented. A handy cross-index of products in industries served is given in an exceptionally useful cross-indexing chart which occupies a full page. Condenser Service and Engineering Co.

233 **Pump Bulletin**—No. 488, four pages, tells about controlled volume chemical pumps with rotary air or gas motor drives for pumping in small volume or at high pressures, or handling difficult or corrosive materials. Discusses motor feed systems, stroke adjustments and merits of special valve construction, illustrated by



—Dependability
—Economy
—Long Life

WIDE SELECTION:

Single and Multi-stage
Pressure range: 0 to 1200 P.S.I.
Capacities: 5 to 50,000 G.P.M.
Types: Horizontal and Vertical
Impellers: Open or enclosed
Casings: Horizontal or Vertical Split, cast iron or bronze
Bearings: Sleeve or ball-bearing

Warren makes pumps *exclusively*. Specialized experience has taught us how to engineer and build the most efficient pump for your job. Thousands of Warren centrifugal pumps are in use by leading companies. Many reorders prove their dependability.

Why be satisfied with less than a Warren? Send an outline of your problem and let us suggest the answer.

WARREN RECIPROCATING PUMPS

Horizontal and Vertical single piston
Horizontal and Vertical duplex piston
Single and Duplex Outside Packed Plunger
Single, Duplex and Compound Hydraulic
Steam Heat Vacuum
Automatic Pump and Receiver, etc., etc.

P-18

WARREN STEAM PUMP COMPANY, INC. SERVICE EVERYWHERE **WARREN, MASS.**

WARREN PUMPS

CENTRIFUGAL AND RECIPROCATING

For: Power Plants --- Chemical Plants --- Paper Mills --- Food Industries --- Metal Working --- Oil and Mining Services

Save Time . . . Labor . . . Money

The New BAUGHMAN Bin-to-Stoker Direct Feed Screw Conveyor

Will Handle 1/2-Ton per Minute

Eliminates wheelbarrowing and shoveling . . . transfers coal at any angle from the horizontal to 60°. Speeds up hopper filling. Practically self-feeding . . . releases manpower for more important duties.

Big 9-inch Conveyor Screw is driven by 2-5 h.p. motor, depending on length. (15 to 50 ft. lengths available.) Direct roller chain and enclosed worm gear case drive at head of shaft. Simple, efficient, trouble-free.

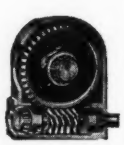
Compact design — quickly adaptable to old boiler rooms and present power plant conditions, or for set-ups requiring a portable unit. Takes up but little room through a wall or doorway.

Open boot end designed for self-feeding as long as fuel surrounds it. Uses tapered screw for more gradual pick-up of materials.

RUGGED CONSTRUCTION

Casing built of 13-gauge, high-tensile alloy steel—17% stronger, and 5 to 10 times more resistant to rust, corrosion and abrasion than ordinary steel. Arc-welded throughout. Heavy, 9" dia. formed steel screw is electro-welded to 2" seamless pipe.

Heavy, machine-finish steel and bronze gear reduction —15 to 1. All gears straddle-mounted between Timken tapered roller bearings, sealed against dirt, and running in a bath of oil.



"If It's HI-SPEED . . . It's BAUGHMAN"

Some Distributor and Dealer Territories Still Open . . . WRITE FOR INFORMATION.

BAUGHMAN

BAUGHMAN MANUFACTURING CO., Inc.
369 E. ARCH ST., JERSEYVILLE, ILL.
"There is a Baughman Distributor Near You"

cut-away drawing. Technical information capacity pressure selection table and diagrams showing pump installation and automatic pH control system. Milton Roy Co.

234 **Compressor Selection Chart**—Here's a new selection chart, based on normal applications handling air with atmospheric intake pressure. It simplifies selection of proper size compressor for average industrial use, with quick comparison between discharge pressure pounds per square inch gage and piston displacement cubic feet per minute and shows recommended compressor bore and stroke in inches. Chart covers two letter-size pages. Worthington Pump and Machinery Corp.

235 **Air Compressor Lubrication Manual**—Valuable information on air compressor maintenance is contained in this 40-page book on the lubrication of air compressors, second edition. Subjects treated include compressed air, compressors and related equipment, lubricating systems, compressor oils and their applications, lubrication requirements operating hints, oil requirements, storage and care of compressor oils, and safety precautions. All discussions are illustrated with large, clear photographs and drawings showing construction and operation of compressors, their lubricating systems, etc. Cities Service Oil Co. (In the South, Arkansas Fuel Oil Co.)

236 **Steam Engine Governor Data**—This new bulletin No. 502, describes the company's Type EN fully enclosed self-lubricated governor which is described as giving "precise, dependable engine speed control." Illustrations of the unit are presented and a parts list, accompanied by a sectional diagram is given. One section "Installation and Care" tells how to assemble governor to engine cylinder and how pulleys should be proportioned, the proper type of belt for use with the governor, correct lubrication procedure, method of packing and other data. Troy Engine & Machine Co.

INSTRUMENTS AND CONTROLS

237 **Recording Instruments Data Book**—A new oxygen analyzer—based on the paramagnetic property of oxygen—is introduced by description and illustration in Bulletin 48-829, 16 pages. Tells advantages and applications of new instrument. Also treats in detail the manufacturer's long-established analyzer for carbon dioxide and other gases, as well as an electronic recorder (which records temperature and pressure, too) for use with the analyzers. Includes discussion of several recommended gas sampling systems. The Hays Corp.

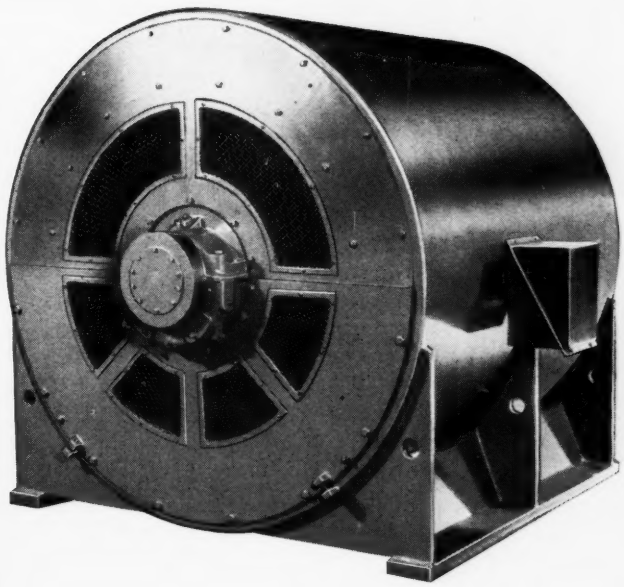
238 **Water Gages** — Eight-page Bulletin E-1 covers line of water gages for stationary and locomotive boilers, marine and refinery service and tanks for all pressures and temperatures. Listings include photos of all gages, sizes and construction details. Bulletin S-2, four pages, covers gage glasses, glass guards, sight flow indicators and related equipment. Ernst Water Column & Gage Co.

239 **Temperature Measuring Instruments**—For all those responsible for the safe operation of electric power equipment, this company has just issued a revised 34 page catalog ND4-33-461 describing the company's instruments for measuring the temperature of generators, motors, condensers, transformers, etc. The bulletin covers a wide variety of instruments, portable and automatic indicators, for checking in any order on temperatures. Reference also is made of new and specialized instruments for measuring in rapid succession a number of bearing temperatures. Leeds & Northrup Co.

240 **Combustion Control**—Bulletin 102-D describes this company's air operated combustion control. Containing 32 pages and bound in a heavy paper cover, the booklet describes completely the application to boilers fired with oil burners, stokers, to furnace draft control and points out its adaptability to any plant layout. Descriptions of the controllers themselves along with integral parts of the units are given. Typical installations of pulverized coal fired boilers are presented in a separate section of the bulletin. Installations

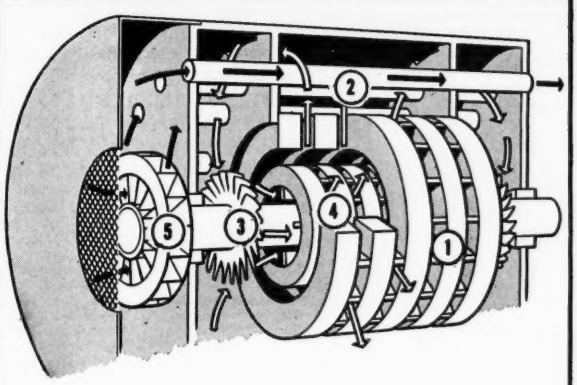
Mark the numbers of the bulletins you wish to receive on the no obligation, no postage card. Pages 35-36.

TUBE-TYPE
TOTALLY-ENCLOSED FAN-COOLED MOTORS!



INSTALL INDOORS or OUT!

How Tube Cooling Works



Stator core (1) is surrounded by tubes (2). Internal fans (3) circulate air through ducts (4) in rotor and stator and around tubes, transferring heat to tubes.

External fan (5) drives outside air through tubes, removing heat and keeping tubes clean. All electrical parts are enclosed. Dirt cannot enter.

- **Dirt-proof and corrosion-resistant**
- **Heat exchanger is practically *self-cleaning***
- **Simple self-contained cooling system—sizes from 75 to several thousand horsepower**

WHEREVER DUST, DIRT, fly ash, rain and snow, smoke, or corroding fumes keep motor maintenance costs high, this Allis-Chalmers tube-type motor will cut maintenance sharply.

All electrical parts—including stator core—are enclosed. Simple heat transfer system keeps temperatures well within rated limits. Cleaning is rarely needed because air passages are unrestricted. Air flow through the straight tubes removes foreign matter.

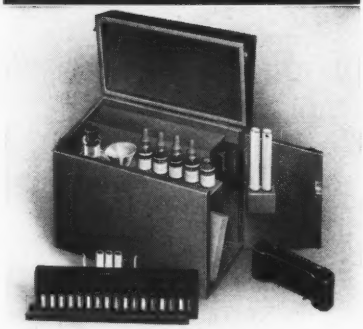
Important savings have been proved in three years of field operation. Sizes from 75 hp and up. Also explosion-proof designs. For complete information, outline your requirements to your A-C Sales Office, or write for Bulletins 05B7150 and 51R7149.

A-2610

ALLIS-CHALMERS, 953A SO. 70 ST.
MILWAUKEE, WIS.

ALLIS-CHALMERS

✓Check BOILER WATER pH and PHOSPHATE



Model P contains either High *OR* Low Phosphate Comparator. Model W contains, in addition, 3 pH slides: pH 7.2—8.8; 8.6—10.2; 10—11.6 and all accessories.

TAYLOR BOILER WATER COMPARATOR

Here's The Simple Procedure

Place the reagent-treated sample in the center tube of the base and untreated samples in the flanking tubes. Move the slide across until the color standard matches the treated sample. Read the etched number on the slide and . . .

Essential Tool Helps Insure Peak Boiler Efficiency

The entire determination takes less than 2 minutes. Accuracy is assured by the unlimited guarantee placed on all Taylor Liquid Color Standards. These Liquid Color Standards are contained in the plastic slide . . . nine standards to a slide . . . a complete set for any one determination. Eliminates the need for handling fragile single standards. Entire set comes in a handy carrying case.

READ THIS FREE BOOKLET

"Modern pH and Chlorine Control" . . . 96 pages . . . contains valuable information for any man responsible for controlling boiler water operation. Write direct for your copy—see your dealer for equipment.

W. A. TAYLOR AND CO.
7301 YORK RD. • BALTIMORE-4, MD

on stoker fired boilers and on oil fired units also are given. Bailey Meter Company.

241 **Boiler Water Level Control** — Bulletin 487 describes completely the installation of boiler water level control equipment at the Blackhawk Generating Station, Wisconsin Power & Light Company. Photographs of the installation are presented as is a schematic layout of the entire station along with tabulated significant data. A large, full-page cross section of the B & W Type FH integral furnace boiler is presented and other drawings and photographs show the accompanying equipment. Northern Equipment Company.

DUST COLLECTING

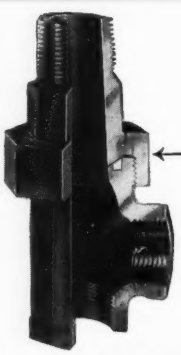
242 **Dust Collectors** — Dust collecting equipment for power plants, foundries, cement plants and similar industries is the subject of Bulletin No. 1428, 26 pp. Contains many photographs of installations, also photos showing equipment being tested in company laboratories. Discusses services offered by manufacturer in analyzing individual installation requirements and recommending equipment for the job. American Blower Corp.

243 **Automatic Filter Bulletin** — A new model 4-stage automatic self-cleaning filter for handling large air volumes and heavy dust loads is introduced in this 8-pp bulletin. It lists important advantages offered by this filter, tells its applications and describes its construction and operation. Includes specifications, performance data and shipping weights. Illustrations include photos of the filter and parts, and a cross sectional layout of equipment used in central air conditioning. Dollinger Corp.

MATERIALS HANDLING

244 **Continuous Weighing of Dry Materials**—Bulletin E4-550 describes the company's new meter for continuously weighing and totalizing the flow of dry materials on conveyor belts. The meter can also be used for the automatic proportioning and controlling of dry or liquid feeders for secondary ingredients. The bulletin describes how the device operates, how it is constructed and gives various features. A double page spread, printed in two colors, presents a typical installation of the unit on a belt conveyor. Blueprint

Specify JEFFERSON Specialty UNIONS



for Leakproof Piping

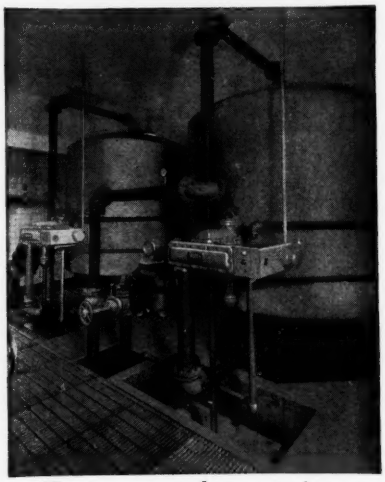
These Union Tees which have the union on the run will be found exceedingly useful where piping involves a union near a tee. They are rated "Tops" by engineers because they simplify installation, save pipe joints and assure permanent leakproofness. Made with pipe ends threaded either All-Female or Male and Female.

The Recessed Brass Joint in Jefferson Specialty Unions provides a brass to iron joint which avoids corrosion. It is forced into a machined recess and processed to insure a thorough, permanent tight contact between the ring and the spherical surface of the surrounding iron.

For complete details, contact us or your nearest distributor.

JEFFERSON UNION CO.
615 W. 26th St., New York 1, N. Y.
7 Green St., Lockport, N. Y.
47 Fletcher Ave., Lexington 73, Mass.

BELCO FULLY AUTOMATIC WATER SOFTENER INSTALLED IN MIDWESTERN MUNICIPALITY



The most recent advancement in automatic water softener control is illustrated above in the Belco motor operated single control valve. This plant produces 1.25 mgd of soft water with exceptionally low operating cost and minimum maintenance.

The unique features of the Belco Multiport Valve are that rubbing rotors are completely eliminated, pressure losses are reduced to a minimum and the high mechanical advantage makes it feasible to use a low H. P. electric motor for valve functions.

The saving in pumping and electrical costs for operating the multiport valve as well as the low chemical cost utilizing Belcolite Resins have resulted in a far more economical plant.

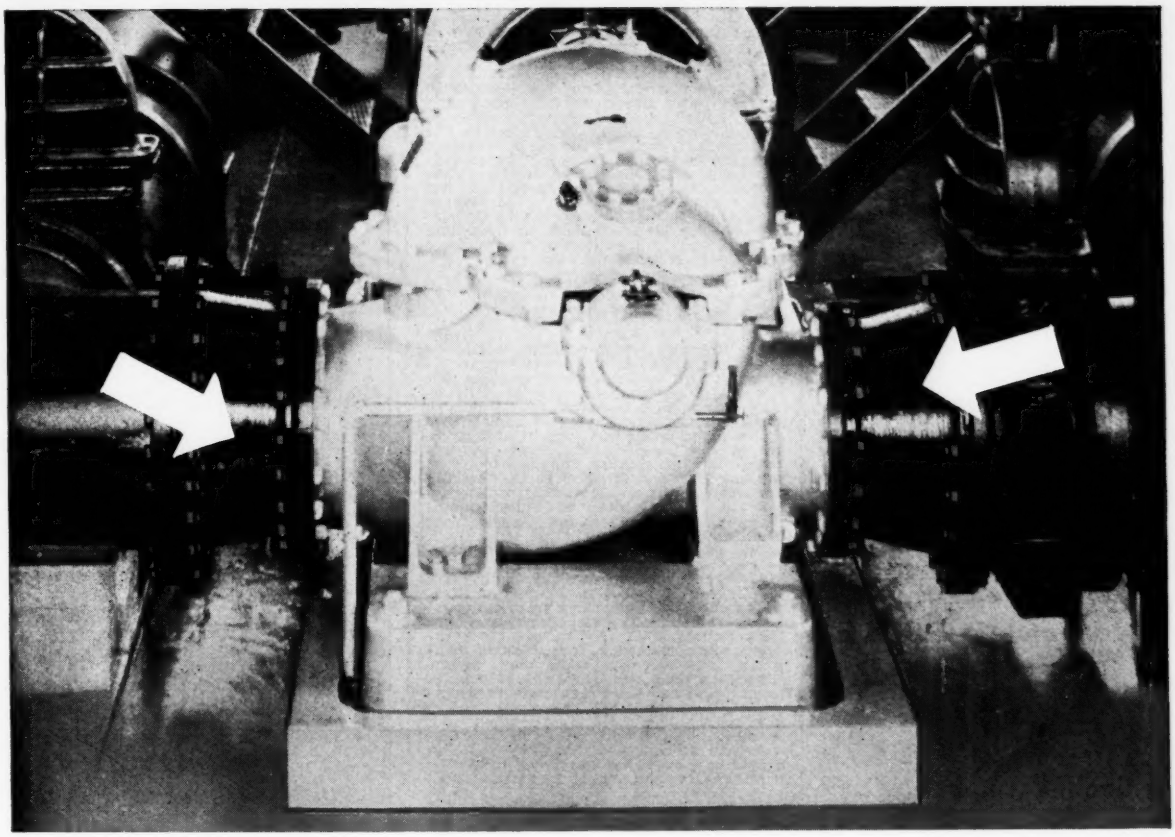
MODERNIZATION RESULTS IN LARGE OPERATING SAVINGS

The Belco automatic valve and Belcolite Resins can be applied to existing water softening installations to lower maintenance and chemical costs to such a degree that in most cases they will repay the original expense in a few months.

BELCO INDUSTRIAL EQUIPMENT DIVISION, INC.
54 Iowa Avenue Paterson 3, N. J.
Midwest: Deady Chemical Co., Kansas City, Mo.
South: Gulf Engineering Co., Inc., New Orleans, La.
Florida Industrial Equip. Distr., Miami, Fla.
Southwest: Watermasters Inc., Houston, Texas
Pacific: Deady Chemical Company, Los Angeles, Cal.

Belco

PROCESSES FOR REMOVAL OF WATER IMPURITIES



REDUCE VIBRATION AND SHOCK WITH "U. S." *(THE ORIGINAL)* RUBBER EXPANSION JOINTS

26 YEARS AGO United States Rubber Company perfected rubber expansion joints. Since that time, these joints have been preventing excess stresses caused by expansion and contraction . . . insulating against vibration . . . preventing the transmission of undesirable sound.

They are light in weight, resistant to corrosion and erosion, can stand higher working pressures, require no gasket between flanges. Both large rectangular and round types are manufactured. Installation is quick and simple.

These joints eliminate costly repairs, increase operating efficiency and extend the life of equipment . . . saving many times their original cost.

Because "U. S." has always been first in expansion joints for over a quarter of a century, you can be sure "U. S. "will provide you with the right joint for your particular purpose.

For more information write Expansion Joint Department, United States Rubber Company, 1 Market Street, Passaic, New Jersey.

FOR HIGH HEAT CONDITIONS

Hy-Heat Type Expansion Joints are designed for *dry* heat up to 400° F. Special asbestos construction.

A PRODUCT OF

U.S.RUBBER
SERVING THROUGH SCIENCE

UNITED STATES RUBBER COMPANY

CONTROL

Scale and Corrosion in Power Plant Equipment

Recently developed applications of the newer colloids and surface-active agents in Wright Chemicals for power plants result in *improved* water conditioning — *positive* scale and corrosion control. Wright Chemicals contain 100% soluble, available chemicals—no waste or inert matter—insuring increased operating efficiency and reduced cost.

Boiler Water . . .

Corrosion and scale-forming compounds in boiler water can be controlled with Wright Chemicals.

Steam and Condensate Lines . . .

Steam and condensate lines can be properly protected by using Wright recommended formulas.

Cooling Jackets . . .

Efficiency of cooling jackets can be substantially increased by preventing corrosion and scale deposits on heat transfer surfaces.

Wright improved chemicals are the result of intensive study and research by men with years of experience in the development, production, application and control of water-conditioning chemicals.

Wright has no one cure-all to solve all problems. Each receives individual treatment. The Wright field engineer, who will call on you upon request, will obtain all necessary information and samples for examination in the modern Wright laboratory. Analyses are interpreted in view of supplemental information received, and recommendations made in the form of a proposal. Clients are provided with regular laboratory service as a periodic check upon conditions.

There is a Wright Field Engineer near you, anxious to help solve your scale and corrosion problems. No obligation.

SEND FOR NEW BULLETIN

giving full information on Wright Chemicals and their applications.

Wright CHEMICALS

WRIGHT CHEMICAL CORPORATION
Specializing in Water Conditioning
GENERAL OFFICES AND LABORATORIES
619 West Lake Street Chicago 6, Ill.
Offices in Principal Cities

type drawings illustrate various applications for the continuous weighing and/or controlling and proportioning and flow of dry or liquid materials. Builders-Providence, Inc.

245 **Dry Materials Conveyor** — Bulletin F-H-1 describes this company's revolutionary type of conveyor designed for the handling of fine, dry materials. The book, which contains 12 pages, presents excellent installation views of the conveyor, and also drawings which illustrate construction and method of operation. The bulletin points out that the conveyor has no moving parts and that it has no hazards to workmen, is silent in operation, requires no lubrication and can pass around obstacles. Fuller Company.

MISCELLANEOUS

246 **Refrigeration Condenser Catalog** — Designated as Bulletin RC-1, this 24-pp illustrated catalog covers ammonia and freon refrigeration condensers of horizontal and vertical construction. Includes specifications, dimensions and applications according to type. Lists weight and prices of available models and includes property tables for refrigerants and safe external working pressures for steel tubes. Sketches and line drawings show construction details and arrangement of units; photos show many installations. Henry Vogt Machine Co.

247 **Industrial Insulation Catalog**—Mineral insulations for practically every purpose are covered in this 20-pp illustrated catalog. It describes in detail insulating cements for both high and low temperatures, high temperature block insulation, block finishes, felts, blanket insulation, pipe coverings, loose wool, weatherproofing and stack paints. Includes information and what each class of insulation is for, what it can be expected to do, how it's applied, how it's packaged and, in most cases, how much it costs. Discusses requirements of a good insulation and tells how these products meet the requirements. Forty-Eight Insulations, Inc.

248 **What's Your Cooling Tower I. Q.?**—Here is a chance to score your knowledge. This company, a manufacturer of cooling towers and spray nozzles, has prepared a series of question and answer type monthly mail pieces with the title as given above. The first of the series deals with water distribution; the second, air movement; the third, facts and figures, etc. Although the subject is technical, presentation is informal and attractively illustrated and makes for enjoyable reading. At the same time the pieces are informative enough to merit serious study and a place in the permanent files of most engineers. The Marley Co., Inc.

249 **Concrete Floors Q & A** — A new booklet titled Lumnite Concrete Floors—Corrosion Resistant and Heat Resistant, has just been published. The detailed information contained in this booklet brings up to date, the service experiences and late developments in this field. The information covers methods and materials used in placing corrosion resistant concrete in a wide variety of industrial applications. Typical uses of corrosion resistant concrete are listed for many industries and also given, are the answers to a number of questions often asked about it. A section on placing and finishing corrosion resistant floors will be helpful to prospective users. Lumnite Division, Universal Atlas Cement Company.

250 **Coal Crushing, Sizing** — Bulletin 3007 describes the company's Bradford breaker a coal crusher, sizer and scavenger. The bulletin presents drawings of the breaker, tells how it works and then presents the complete story of its operation at the coal mine and coal cleaning plant at the By-Product Coke Plant and at the Power Station. The back section of the catalog presents engineering information on capacities, dimensions and dimensioned line drawings. Pennsylvania Crusher Company.

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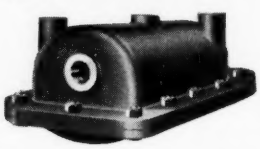

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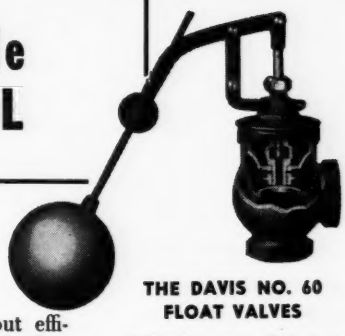

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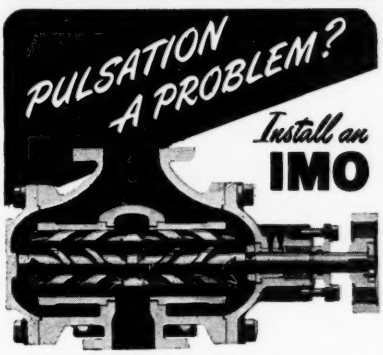

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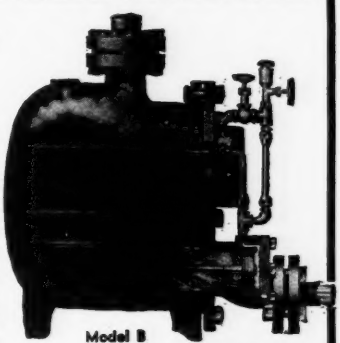

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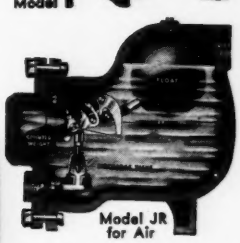

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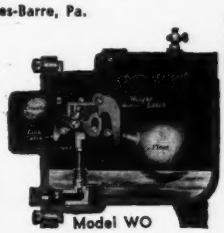
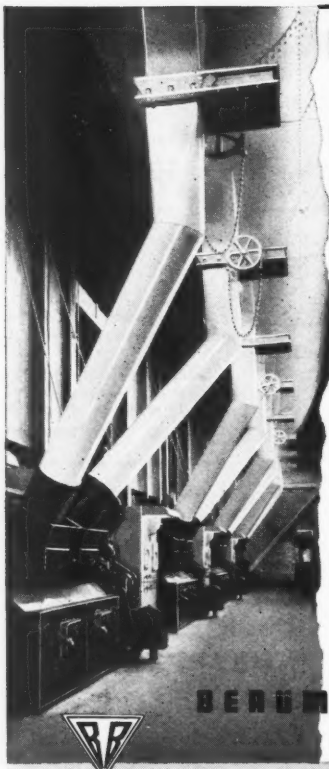


Model WO

CATALOG 448 or see Sweet's



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Handbook of Industrial Electronic Circuits by John Markus and Vin Zeluff. First Edition; size 8½ by 12 in.; illustrated; 272 pages; cloth. Published by McGraw-Hill Book Co., 330 West 42nd St., New York 18, N. Y.; 1948. Price $6.50.

The purpose of this handbook is to provide busy engineers with a ready source of information about the circuits he needs for particular industrial electronic applications. The significant work of other engineers has been collected in this one handy reference volume to save hours and even days of search through technical literature.

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The authors are both associate editors of "Electronics" and most of the material contained in the book naturally is drawn from Electronics. Over 400 circuits are from Electronics. The others were taken from other sources and, wherever possible, the original source for each circuit is indicated. In short, these circuits reflect intensive research in hundreds of magazines and periodicals and represent the work of the leading men in the field. The book should be valuable for every engineer who has occasion to solve electronic problems.

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Basic Electrical Engineering by George F. Corcoran. First Edition; size 6 by 8¾ in.; 450 pages; illustrated; cloth. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y.; 1949. Price $4.50.

Of the many outstanding features of this book, one of the most important is the simple and direct method by which magnetic field concepts are handled. Rare, indeed, is the textbook of electrical engineering which maintains throughout a level suitable for beginners. This book does just that.

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Elements of Mechanical Vibration by C. R. Freberg and Emory N. Kemler. Second Edition; size 6¼ by 9 in.; 227 pages; illustrated; cloth. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y.; 1949. Price $3.75.

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Elements of Applied Hydrology by Don Johnstone and William P. Cross. First Edition; size 6½ by 9¼ in.; 276 pages; illustrated; cloth. Published by The Ronald Press Company, 15 East 26th St., New York, N. Y.; 1949. Price $5.00.

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Smoke by Arnold Marsh. First Edition; size 6 by 8¾ in.; 306 pages; illustrated; cloth. Published by The Sherwood Press, P.O. Box 566, Pacoima, Calif.; 1948. Price $7.00.

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Standard Handbook for Electric Engineers, by Archer E. Knowlton, Editor-in-Chief; eighth edition; size 6½ by 9¼ in., 2311 pages; illustrated; bound in flexible fabricoid; published by McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 18, N. Y.; 1949. Price $12.00.

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Industrial Electricity, Volume II, Alternating Currents, by William H. Timbie and Frank G. Willson; First Edition; size 6 by 8¾ in., 781 pages; illustrated cloth. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y., 1949. Price $5.96.

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Patent Law by Chester H. Biesterfeld. Second Edition; size 6½ by 9¼ in.; 267 pages; cloth. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York, N. Y.; 1949. Price $4.00.

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The Science and Engineering of Nuclear Power, Volume I and Volume II, edited by Clark Goodman. First Edition; size of both volumes 8¼ by 10½ in.; Volume I, 536 pages; Volume II, 342 pages. Both volumes bound in cloth and fully illustrated. Published by the Addison-Wesley Press, Inc., Cambridge 42, Mass.; 1947. Price of each volume $7.50.

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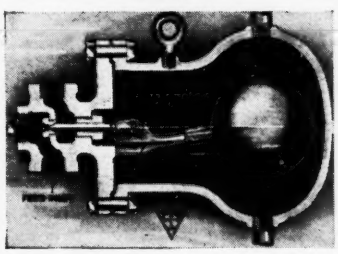

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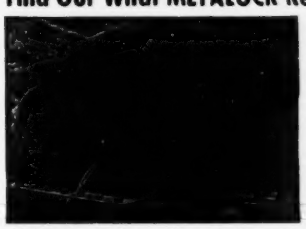

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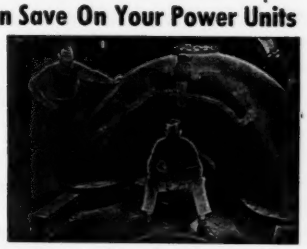

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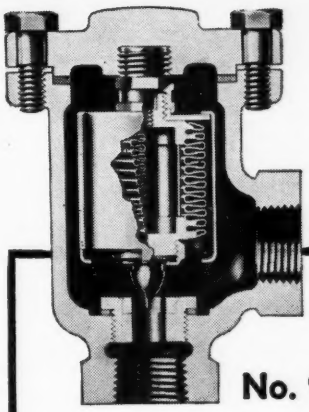

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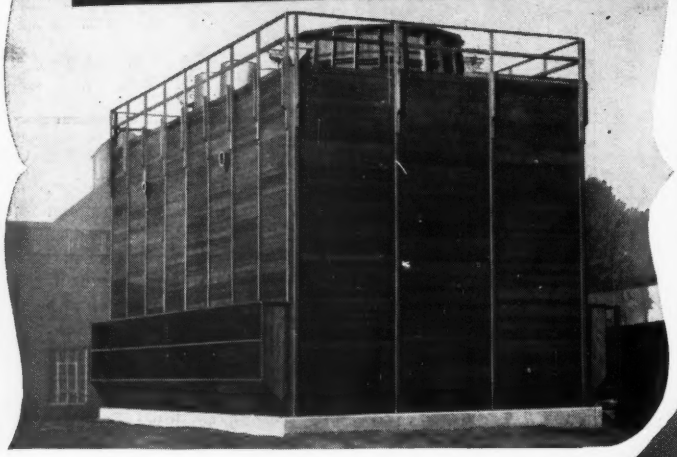

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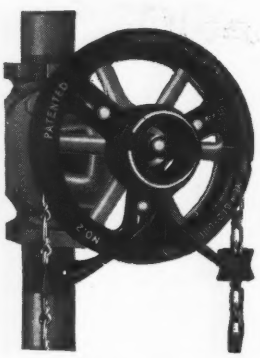
with the LOW-COST



Babbitt
Adjustable
SPROCKET RIM
with Chain Guide

Range of 10 adjustable sizes takes care of all valve makes and types; fits valve wheel diameters from 2 to 30 inches.

Overhead valves—no matter how high, or in whatever hard-to-get-at location—are instantly accessible from the floor. Operation is quick, easy, positive and safe with the BABBITT Adjustable Sprocket Rim with Chain Guide. No more climbing on bench, machine, boiler or treacherous stepladder; no time-wasting.

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Match Your POWER *with Lovejoy*

For speed-up smooth power flow full production freedom from shut-downs

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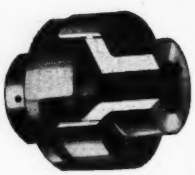

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CHAPMAN VALVE List 960

Gives more than 50% increase in strength of stem and wedge gate connection...meets the most extreme operating conditions.

Valve stems and gates with the new scientifically designed connection are interchangeable with all List 960 Valves now in service

Here's one more result of the year after year program of research which Chapman carries on to make the List 960 *tops for toughness.* Reason why this small gate valve can lower your maintenance cost — give you more years of useful valve life.

Consistently you will find the Chapman List 960 is *your best valve buy.* It is available in sizes ¼" to 2" . . . rising stem with yoke (as illustrated). Also available rising stem inside screw type. For pressure range 2000 lb. at 100 deg. F., 380 lb. at 1000 deg. F.

For higher pressures specify List 990.

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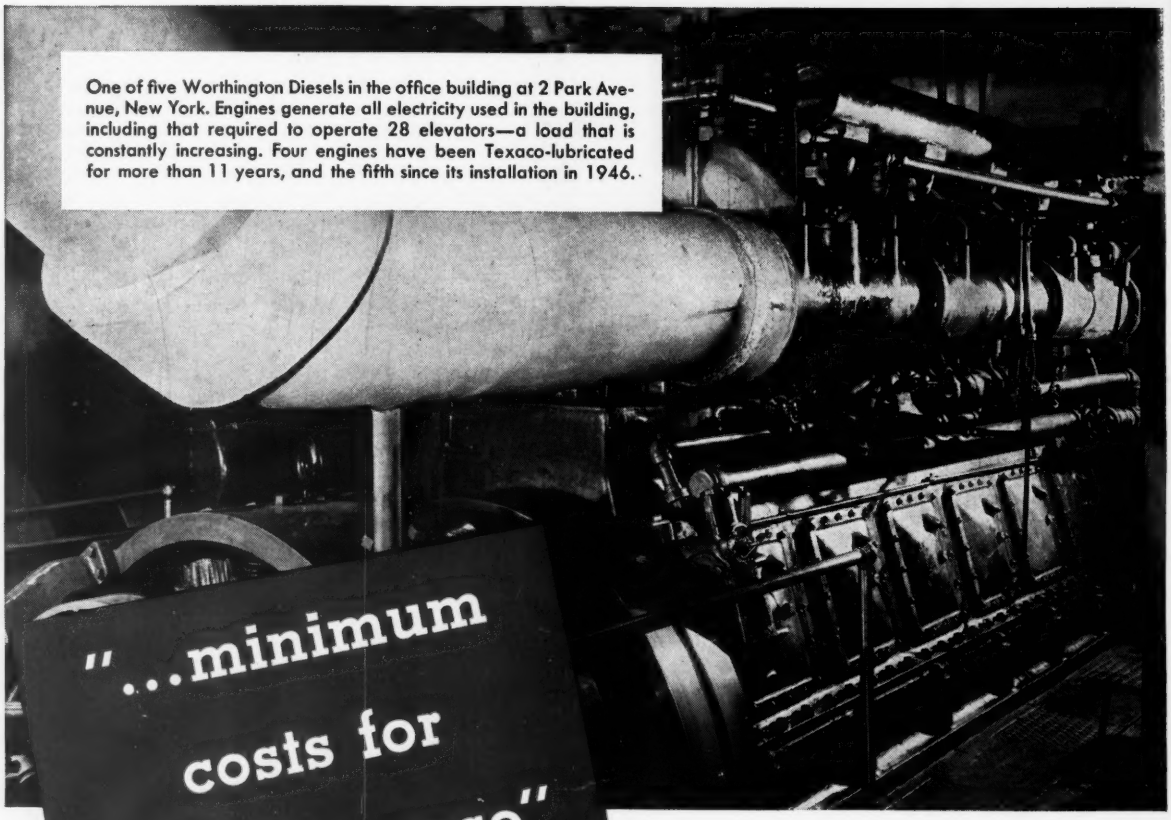
And don't forget the wear resisting and non-galling properties of the hard heat treated seat rings and the 800 Brinell hardening of the wedge faces by the exclusive Malcomizing Process.

The Chapman Valve Mfg. Co., Indian Orchard, Massachusetts



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